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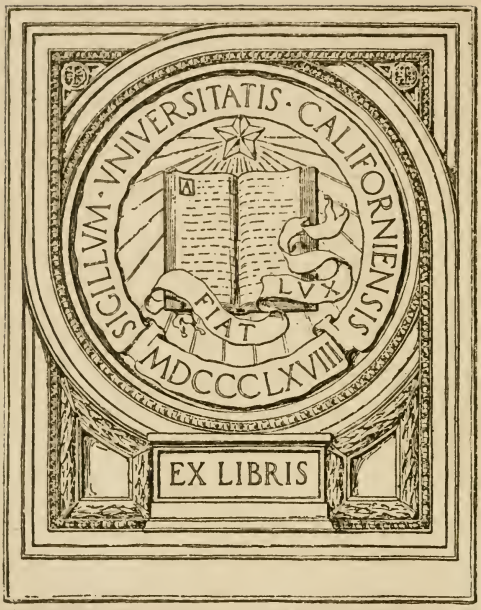

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THE EYES OF OUR CHILDREN

BY

N. BISHOP HARMAN

M.A., M.B. CANTAB.

FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND

WITH THIRTY-TWO DIAGRAMS

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PREFACE

THE sight of the eye is the most precious of our senses; through the eyes we learn most and can teach most; and through them we may suffer if they be defective or ill-used. Sight has determined the very form of man: the upstanding frame, the free acting arms, 'his fair large front,' the diminished snout and the developed chin are all features related to sight. More striking still is the massive brain and the cunning craftsmanship that are the fruits of perfect two-eyed vision. The influence of sight is no less strong in the individual. Blindness is a calamity few can weigh; and in their degree defects of sight, whether by reason of disease or natural imperfection, affect mind and habit. The short-sighted boy becomes a round-shouldered smug, a book-reading recluse, just because the pleasure of games has gone with the power to see clearly and smartly; another boy has eyes that focus near objects with difficulty, and that boy hates lessons, and, not unwisely perhaps, plays truant at every opportunity. The influence of sight on the whole attitude of the child, both mental and physical, is so great that no pains should be spared to secure

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the eyes from injury and to remedy those defects that may be inherent in their working. It is of interest to note that the first step in school hygiene, and all this has meant for the health and happiness of youth, was made in relation to the eyes.

This little book deals with the eyes of the child, their common defects, and the best means of safeguarding their use at school and at home; it will be found to be free from hard words and technical phrases, so that all who are interested in children may read and understand.

N. B. H.

January 1916.

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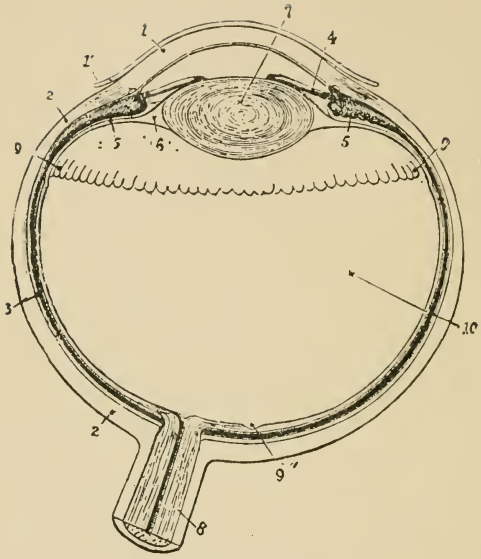


FIG. 1.—SECTION OF AN EYE.

1, cornea; 1', conjunctiva; 2, hard coat or sclera; 3, blood coat or choroid; 4, iris; 5, focusing muscle; 6, lens ligament; 7, lens; 8, optic nerve; 9, front fringe of retina; 9'', central spot of retina; 10, jelly packing eye.

UNIV. OF CALIFORNIA

THE EYES OF OUR CHILDREN

CHAPTER I

THE EYE OF A CHILD

THE simplest form of eye is a speck of pigment. Such an 'eye' may be seen in the amœba, the lowest form of animal organism.

Pigment is the first necessity for the reception of impressions of light. There are born on occasions boys and girls, white children and even negroes, in whom the body is devoid of pigment. These abnormal children are called albinos; their sight is bad, some are blind.

FIG. 2.—EYE OF PEARLY NAUTILUS.
h, hole; *c*, cavity; *r*, retina; *n*, nerve.

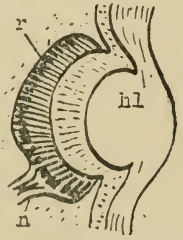
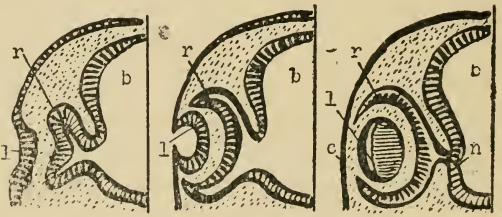


FIG. 3.—EYE OF SCORPION.
hl, horny lens; *r*, retina; *n*, nerve.

In other lowly creatures we find eyes that are more complex. In the pearly nautilus there is a focusing

arrangement. There are little pits open to the water; each of these pits is screened by a circular cover which narrows the mouth to a small hole. This chamber is like the pinhole camera with which many a boy has made sun pictures when no finer apparatus was available.

In the scorpion there is a thick plate covering the eye; the plate is part of the shell of the body, but it is transparent, like the horn spectacles of our forefathers.



FIGS. 4, 5, 6.—STAGES IN THE GROWTH OF AN EYE.
l, lens; *r*, retina; *b*, brain; *c*, cornea; *n*, nerve.

From eyes of these simple characters to the complex eye of a man is really a very short step. There is only a gradual development of the primitive essentials and the addition of accessories, and these improvements can be witnessed in many fishes, reptiles, and animals.

In the growth of each human embryo there is first a cup on the surface of the growing skin, and beneath that a cupped protrusion from the growing brain. These two cups meet. The skin cells become

separated from the surface and embedded within the head of the embryo, whilst the brain cup grows round them. That is an eye in being; the surface cells form the focusing lens, the cup from the brain all the sensitive layers of the eye with the pigment cells. The equipment of the eye grows from the loose tissue between the skin and brain layers; from that loose stuff there consolidates the stiff coat of the eye, and the blood-vessel coat, whilst a remnant makes the jelly that packs the cavity of the eye. Muscles and nerves form within and without it; and at birth a human eye is found, albeit immature.

The last word is the keynote of this chapter. The eye of a child is an **immature** eye. It is a growing eye when the child begins to learn lessons. And it must be treated with the care that immaturity demands. We all recognize that the slender back of a child is no fitting place on which to heap burdens, that its arms are weak, and its hands incapable of grasping heavy weights; but very few seem to understand that the eyes of a child are as undergrown as are the other members of its body, and from failure to recognize that fact much mischief is done.

The eye of the new-born babe is apparently complete in all its parts, but it has precious little vision. It may be weeks before the infant will notice the stimulation of a light, much less recognize the most familiar object of its existence.

We may watch the actual growth of the eye. The

slaty-blue iris of the new-born may be seen to clear so as to display the underlying texture and give the effect of a blue eye, or else we may see the gradual appearance of pigment to the painting of the brown eye. Even tears are absent when the child is born, and it may take two or three weeks before this comfortable secretion is established. The smallness of the eyeball may be noted by any judge of size, and if the observer will compare the appearance of the front of the eye of an infant with the eye of a full-grown child he cannot fail to notice in the infant the shallowness of the space separating the clear watchglass front of the eye and the coloured iris beneath, a condition that is due to the smallness of the globe and the lack of space to accommodate the focusing lens within it. Even the pupil of the eye will be seen to be different; it will be found to be very small, quite different to the full black pupil of the grown child, and that small pupil is a protective agency shielding the infant eye from an excessive stimulation of light.

These observations of the growth of the eye in babies are but the more striking features of a growth that continues far into school life, and the whole of this development is dependent upon proper and balanced stimulation. Contrariwise, a very short disturbance of the normal stimulation of light will arrest the growth of the infant eye; and irregular or too severe or prolonged stimulation to the eye

of the school-child will tend to the production or accentuation of defects. An extreme case will best show what is meant.

The disastrous effects of the purulent inflammation of the eyes of the new-born (*ophthalmia neonatorum*) is explained in the chapter on 'pink eye.' In some of these cases the front of the eye is irreparably damaged, maybe the eye is lost. There are other cases in which the disease has been stopped with little apparent damage; but in later years some of these children will have eyes constantly on the move, with a fine shake from side to side that never stops except when the child is asleep. This shake is called 'nystagmus,' and its presence means that the growth of the eye was stopped during the time that the eyes were inflamed.

Similarly, the improper exercise of the eyes in the growing years of a child either by reason of bad or excessive light, the use of improper materials, prolonged close work, or of any work at all during conditions of poor health, will account for the onset of eye-strain, squint, short sight, and even mental fatigue of a serious order.

The one lesson that must be learned by every one who essays to be the teacher of the young child is the immaturity of the eye. We may well apply the words of Edward Young:—

> 'Beautiful as sweet,
> And young as beautiful, and soft as young.'

CHAPTER II

SORE EYES

'NOW Leah was tender eyed.' Such is the rendering by Tudor translators of a passage in the Pentateuch. It has the tone of apology. Leah was a woman who suffered, and was remarked among a race of bright-eyed people.

The condition of sore eyelids goes by the name of 'Blepharitis.' That word indicates an inflammation of the structures of the margins of the lids. The eyelids are folds of skin. The skin surface of the lids is thin, soft, and supple; it is very loosely attached to its supporting tissue, so that when the lid is moved or drawn up as in opening the eyes wide, the skin is thrown into folds which fit beneath the brow better than any patent blind within its frame. On the surface next to the eyeball the lid is stiffened with a thin plate of tough tissue, and lined with a delicate slippery membrane that unites the lids to the eyeball. This membrane is called the 'conjunctiva,'—that which joins. Between these two surfaces, the dry outer surface and the moist inner surface, is the true edge of the lid. These edges come

into contact with each other many hundred times each day without—in healthy people—the least sign of distress. This immunity is the result of the arrangement of the grease glands set in the edge of the lids.

There are no scattered sweat and grease glands on the conjunctiva as there are on the ordinary skin. They are not needed; the conjunctiva is unctuous by reason of its mucus. The sweat glands have been collected together to form the tear glands, which are tucked away into the corner of the eye-socket, whence they issue their bland secretion to wash the eye when occasion or sentiment should stimulate them. The grease glands are now arranged in line, like soldiers, with their mouths opening on to the edge of the eyelids, where alone there is danger of friction or soreness.

The secretion of these glands coats the margins of the lids with a layer of smooth grease, so that they do not come into contact directly with each other. The grease is not sticky, so the lids open as readily as they close. And lastly, and by no means least, the grease coats the margins with a natural water-proofing, so that, so long as the secretion is healthy, the margins are not wetted by the tears. When this secretion is defective in these qualities there follow those symptoms and changes in the lids that we know as blepharitis.

Blepharitis is one of the commonest of eye diseases

amongst children. One year I examined 22,000 school children in London elementary schools, and found 351 cases of sore eyes; of these 270, or nearly two-thirds, were varieties of blepharitis. The disease is much more common amongst children than adults, amongst very young children than older children, and amongst the dirty and ill-kept than amongst the clean.

The onset of the disease may be sudden; then it is usually due to some fever, such as an attack of measles. The fever causes some soreness of the eyes, and this attack starts chronic sore eyelids if the other conditions are favourable. But the chronic form may start so quietly that no one remarks it, and it is not until some damage is done and the disease has got a secure hold on the lids, that attention is called to it. In the earlier stage there is only a little dry, white, bran-like material fixed on to the lashes like papers on a file. After much reading and particularly after doing fine sewing, the edges of the lids will be found to be pink instead of yellowish white, and the rate of blinking will be increased. Later the redness of the margins—the 'weakness of the eyes'—is noticed all day long.

Crusts form and accumulate about the lashes and provide excellent breeding-places for the abounding microbes; small ulcers form under the crusts, and if we remove these we find raw, bleeding surfaces. The disease spreads into the roots of the eyelashes

and kills them, so that they fall out and are not replaced. There is set up a vicious circle; the blepharitis predisposes on even the slightest provocation to attacks of conjunctivitis and eczema of the skin, and these in turn exaggerate the blepharitis. Ultimately, in bad cases, both the eyelashes and the grease glands may be totally destroyed, and the lids left with an unsightly, red, tender-looking margin.

Three factors go to make up the liability to the disease :—

1. The subjects of the affection are most frequently possessed of skin and hair which are thick and greasy, and they are liable to 'blackheads,' acne, and dandruff. There is then the susceptible **soil.**

2. The subjects of the affection will, when their eyes are accurately examined, most commonly be found to have an error of focus; generally they are astigmatic, so that close work irritates the eyes. There is in this factor a **preparation of the soil.**

3. Lastly, there is the never-failing presence, in even the cleanest persons, of microbes about the lid margins. There is then plenty of **seed** ready to hand for sowing.

The relations between these three factors are very definite. But the factor of greatest importance, certainly in the chronic cases, and those cases that occur in the children of the better classes where cleanliness is all that could be desired, is the second of the three—the **preparation of the soil.** The defect

of vision may be very slight, but when the child is put to close and difficult work, especially when from any condition of general ill-health there is an unusual liability to fatigue, then the ready tiring of the eyes and the suffusion of tears cause repeated blinking, so that the margins of the lids tap, tap, tap against each other with far greater frequency than is normal. The soil, naturally susceptible, is slightly irritated by the mechanical stimulation, and prepared for the reception of the seed.

To cure a disease dependent on three clearly defined causes, all of which are well within our control, should not be difficult, and it is not, provided it be undertaken early. The plan of the cure may be drawn up with delightful brevity and precision—clean the lids and remove the cause of the irritation.

Every scrap of bran or crust must come off the eyelids. Frequent bathing with an alkaline lotion—simple bicarbonate of soda in water—will soften and dissolve them. Then the application of a smooth, mild, antiseptic ointment will keep the lids soft, and reduce the liability to the collection of more crusts and scabs.

These means will do much to reduce the unsightly ravages made by the disease, but they will not touch the thing which is at the root of it, and is the real cause of the irritation. To get at this the vision of the eyes must be examined by an expert in eye work,

and any irregularity in the focus of the eye must be corrected by the wearing of spectacles.

Spectacles are not things of beauty. But it is a choice of evils—spectacles or worse. Certainly spectacles are decorations compared with the raw, red, lashless eyelids that are the end of chronic blepharitis.

CHAPTER III

PINK EYE

THE term was originally applied to inflammation of the eyes in horses, but it has become attached to similar conditions in human eyes, the more particularly since outbreaks in certain schools attracted the attention of Parliament. The term merely intimates that the eyes are red, whereas we all know that the healthy eye should show a clean white surface. The common people use the term 'blight.' Neither terms define any particular condition; they merely indicate that there is something bad about the eyes.

Pink eye or blight is caused by many varieties of noxious irritations. Some of these are the direct outcome of the infection of the surface of the eye with microbes, some are the outward and visible sign of an inward and physical ill-condition.

There is a membrane lining the inner side of the eyelids and covering the exposed part of the eyeball called the conjunctiva. It bears the same relation to the eyelids and the front of the eye as does the silk lining of our clothes. It is much more delicate

than the structures it lines, and it dips down and folds into all their crevices and crannies.

The membrane has two layers. There is an underlying fabric which is a tangle of fine fibres; it holds the blood vessels and nerves that nourish and sensitize the membrane. There are also a very large number of little clumps of cells; these are the exact equivalent of the tonsils of the throat, and they are filters to catch noxious matter that falls on the membrane.. The second layer of the membrane is the surface layers of cells which give the conjunctiva its particularly delicate polished appearance. These cells are different to the cells that cover the general body surface in one particular, for they are not dry but moist; each cell gradually prepares within itself and becomes filled with a thin slippery substance called mucus, and when the cell comes to maturity it bursts and disgorges the mucus which, spreading over the surface, keeps the whole moist and slippery so that the movements of the eyes are facilitated.

The conjunctiva is variously attached to the structures that it lines. Above the upper lid it forms a deep pouch so arranged that the movements of the lid and of the eyeball upwards are not restricted. This pouch is the place where foreign bodies, dirt and pieces of grit, are very likely to get lodged when they get into the eye. That part of the membrane which covers the eyeball is attached to the globe in the loosest manner possible; this is

shown in any severe inflammation, for it readily swells up into a balloon-like cushion and bulges between the lids, forcing them apart. There is one exception to this looseness of attachment in that small part that covers over the very front of the eye, the clear watchglass-like structure which goes by the name of the 'cornea.' On its surface the cornea has several layers of delicate transparent cells, and these are the cells of the conjunctiva which are specially arranged to protect the cornea and preserve its perfect transparency. Should these cells get damaged there is a corresponding loss of clearness of the cornea, and the sharpness of the sight is reduced, either for the time during which the attack lasts, or permanently if it be severe.

The conjunctiva is very sensitive. Most of all that part of it which covers the very front of the eye, the cornea, is exquisitely sensitive to the least irritation. This delicacy has given occasion to the well-known biblical simile, 'the apple of the eye.' And the simile is a very true one, for on this delicate sensibility the very sight of the eye depends. In some diseases the sensibility is lost because the nerves are defective. Then there is nothing to warn the eye when dirt settles on the cornea; the membrane ulcerates, until the whole sight may be destroyed. The same may take place when children are unconscious, in meningitis or brain fever, or in typhoid fever; then they lie with their lids slightly parted,

the front of the eye becomes dried, and the cornea may be destroyed if the eyes be not protected.

Inflammation of the conjunctiva is known by the name 'conjunctivitis.' There are many varieties of this disorder, and they differ according to the cause of the inflammation. There is one that is a very common liability of children. It appears in epidemics. When it gains entry into a household or school it may spread throughout that family or school. On occasions the disease has run through a whole city. The inflammation is caused by a particular microbe. It was first found out in Egypt, and is called after its sponsors the Koch-Weeks bacillus. It is one of the minutest microbes that attacks the human body, and is very like that bacillus which causes influenza. The two organisms are alike in appearance under the microscope, the way in which they grow in our incubators, and also in the manner of their attack upon the body. Both cause smart epidemics, both are very contagious, and both leave weakness after an attack.

This organism is conveyed for the most part by the hands, generally of the person who becomes affected. That explains how much more frequently dirty persons are attacked by contagious eye affections than are clean persons, and also how much more frequently children are attacked than either clean or dirty adults. Next after the hands of the person attacked the most common means of conveying

contagion are towels and other toilet articles. When an epidemic of this or any other eye disease runs through a school there is always reason to suspect the toilet arrangements. Every child should have his or her own towel, sponge, hair-brushes, and tooth-brushes. It goes without saying that this should be so. But it takes a good deal of arrangement to ensure the continuance of such regulations. Not only must this care be carried out in the school proper but it must be rigorously adhered to in the sports pavilion, for there, as easily as anywhere else, contagion may be conveyed by the common use of towels. Not so long ago there was an epidemic of a common skin trouble, 'impetigo,' which went by the school name of scrum pox. The epidemic was due to the spread of a common pus-forming microbe, a coccus, by the use of towels in common in the sports pavilions of several schools; the visiting teams carried it from school to school until the means of communication was cut by the insistence on ordinary methods of cleanliness. Quite recently I had to investigate the occurrence of an epidemic of eye inflammation in a large day school run by a religious organization. It was impossible to secure individual towels, so the issue of towels was stopped entirely. No child was to wash in the school; if it came dirty it was to go home to wash. The epidemic was stopped promptly in all except one class, that of the senior girls; there it continued despite all pre-

cautions. The flaw in the arrangements was an enigma, until the teacher of that class was examined as to what went on in the class. Then it was discovered that the girls were working for a prize needlework competition, and to secure the cleanest work she was in the habit of sending the girls to wash before that work was done, and since all towels had been withdrawn she had given them a piece of 'clean' linen to use. That piece of stuff went the round of the class, so there was no wonder that the epidemic was not stayed.

That disease is spread by the direct conveyance of particles from person to person is a fact that has been established in comparatively recent years. Before the certainty of this means of communication had been established it was held that miasma, vapours, effluvia and the like were responsible for the origin and spread of disease. The distinction between these two modes of communication is of chief importance, especially so in regard to the responsibility of those in authority for the outbreak and continuance of epidemics of eye disease. If some subtle intangible miasma is the *fons et origo mali*, then who is to blame for the trouble? It is fate! But if it be certain that this child had the disease and passed it on to that child, and so on through the whole school, then it is clear where the responsibility lies.

Leaving the causes and means of communication of epidemics of eye disease, we may consider the

symptoms of common conjunctivitis. These vary with the intensity of the attack, but whether the attack be mild or severe certain signs can be recognized. The one that most strikes the onlooker is the altered colour of the eye, hence the term 'pink eye,' but it must be borne in mind that this symptom is not characteristic of one form of inflammation only; it is common to every form of inflammation that affects the front of the eyeball. Next there is always some swelling where there is

FIG. 7.—MATTER FROM EYE MAGNIFIED 1000 TIMES.
The rods are the microbes; *l*, pus cell; *e*, scale cell from conjunctiva.

inflammation, and the delicate elastic conjunctiva very easily becomes swollen; the same symptom may extend to the eyelids, so that in severe cases they also are swollen and glassy-looking, for the natural folds and creases of the lids are smoothed out. Next the discharge calls for notice, and this is the specific feature of a conjunctivitis. There is an extra flow of tears, and these tears are flecked with little pieces

of thick whitish or yellowish material; this is purulent matter, or pus mixed with the mucus of the eye. It tends to gather at the inner corners of the eyes, and to clog the lashes, so that in the morning when the patient awakes from sleep the eyelids may be stuck together so tightly that the eyes cannot be opened without first bathing them. It is this discharge which carries the specific contagion of the disease. If a film of the pus be made upon a slip of thin glass, stained in an appropriate fashion, then examined under the high powers of the microscope, numerous short slender rods will be found. To the presence of these on the surface of the conjunctiva and deep down in the many folds of membrane all this irritation is due. The irritation is so marked that many sufferers are convinced they have 'got something into their eye,' and truly they have, but not something of the nature they suspect. The complaint of 'sand and grit in the eyes' is due to the irritation of the endings of the nerves of the conjunctiva; these have been trained from the beginning to report to the brain the presence of specks in the eye.

Another symptom is intolerance of light, or 'photophobia.' This is severe in proportion to the effect the inflammation has on the cornea of the eye. Hatred of light leads the sufferers to hide in the dark, and it also leads kindly disposed persons to cover the inflamed eyes with bandages, or even poultices.

But it is bad practice to bandage eyes when there is discharge containing pus or thick matter. The pus is kept within the eyelids, and the microbes multiply, so that in the end the disease is made much worse. Bandaging the eyes does for the microbe the very thing that we do when we wish to grow it in the laboratory incubators; it keeps it warm and snug, and as free from disturbance as may be. It is far better, in the absence of expert advice, to wash the child's eyes, and keep on washing them so as to remove every trace of matter from the eyes, for the repeated removal of the pus-laden tears will so reduce the number of microbes that the conjunctiva will be able to recover from the effects of the invasion. When there is no doctor to direct treatment it is a safe rule to wash well and often. If Naaman the Syrian required to wash seven times in Jordan to be rid of his skin disease, it is good to wash the child's eyes seventy times seven to keep them free from matter. There may or may not be any drug or antiseptic in the water; unless a doctor orders a lotion it is better to refrain from amateurish experiments.

There is another form of eye inflammation, particularly an affection of children, known as phlyctenular conjunctivitis. The word phlycten means a blister or bleb. Small whitish spots or blebs appear at the rim of the cornea, at the head of a cluster of intensely inflamed vessels. Since

they appear at the very edge of the cornea, the region of greatest sensibility of the eye, the pain caused by the attacks is intense. The children keep the eyes firmly closed, any attempt to look at them causes cries of pain and resistance, and if the lids are opened (as they must be to effect treatment) hot tears will spurt from between them. These cases demand urgent and careful attention, for if they be neglected very grievous injury may be done to the sight. The little elevations break down and ulcerate, and the ulcers spread across the surface of the naturally clear cornea, scarring it, so that the sight is permanently injured. There is no disease that is responsible for more damage to sight than is this.

In a group of three hundred children whose vision I had to examine on account of such serious defect that they could not be educated at an ordinary school, and yet who were not bad enough to require teaching at the blind school, it was found that no less than fifty were cases of this sort; both eyes were seriously damaged by the 'blistering' inflammation.

This disease differs in one respect from other forms of pink eye, for the phlycten is not the direct production of microbes. When the little bleb is examined by microscopic methods in a fresh and undamaged state we find that it is sterile, but when it has broken down and ulcerated many organisms are found on its surface.

If the records of a large number of children are examined we can learn many things about the disease. The cases are most frequent at the age of five years. Among the sufferers from this disease there is an unusual frequency of associated troubles, such as enlarged tonsils, adenoids, sore noses, mouth breathing, and decay of the teeth. Jewish children, for the most part aliens, are very little liable to the disease, though they are relatively more often affected by microbic forms of pink eye and sore eyelids than native children. The little blebs appear on that part of the cornea supplied by twigs of the big nerve which supplies the teeth.

Putting these facts together we get a connected story. It appears most frequently at the age of five years, just the time when the milk teeth are decaying. If at this time the mouth be neglected there is a swarming of microbes, so that there is great liability to sore throat, sore nose, inflamed glands, and the like. All these happenings are more likely to produce trouble in weakly children whose resistance is feeble, than in robust, well-cared-for children. In the weakly children the summation of all these surface irritations sets up an irritable state in the nerves, and there is an outbreak of these little blisters at the endings of those nerves most nearly connected with the seat of the maximum irritation in the teeth.

The disease is primarily one of bad general health.

The irritations of the teeth and mouth are like the last straw that broke the camel's back. The alien Jewish children escape the disease because they are among the best fed in the metropolis. Their staple food is richly impregnated with oil; the children are fat and round, and their resistance to the effects of irritations of eyes, nose, and mouth is proportionately good.

There is no disease that is more ameliorable by treatment on right lines than is this. The first thing is to improve the general health of the child. Clean up the teeth, make the mouth healthy and sweet. Remove excessive growths of tonsils and adenoids. Feed the child with plenty of milk, butter, and cod liver oil. Best of all, take it to a warm, dry place where it can be in the open air all day, and the disease will be stopped and the danger of relapses removed. The treatment of the local eye condition will need the care of an expert, but his services will be unavailing unless the state of the general health be attended to at the same time.

Amongst the poor and ill-fed children who form so large a proportion of the out-patients at our metropolitan hospitals these cases have a high incidence. Their attendance drags on for weeks and months unless steps are taken to transfer them to convalescent homes, when the cure is magical in its swiftness. There is no greater testimony to the value of convalescent homes, and of open-air schools,

than cases such as these. On the mere ground of values the homes are justified, for the saving of a pair of eyes may mean in later years the difference between a life of happiness and a life of constant worry; between a future as an unemployable ne'er-do-well and a good workman; and between one who is a source of wastage of the public wealth and one who adds thereto.

There is a form of conjunctivitis which is marked by intense inflammation and the pouring out from the eyelids of thick yellow matter or pus. This is called **purulent conjunctivitis.** It is most frequently seen immediately after birth, and in this connexion goes by the name of 'ophthalmia neonatorum,' that is, the eye inflammation of the new born. It is one of the most serious types of inflammation known, and is responsible for more blindness than any other single form of inflammation. Of all the children in the blind schools of Europe and America from one-fourth to one-third owe their pitiable state to this one cause.

The disease affects rather less than one in every hundred children born, and it destroys the eyes in about one in every two thousand children born. It is due to a microbe getting into the eyes of the child during the process of birth, and the microbe that produces this intense form of inflammation is the cause of one form of venereal disease.

It must not be thought that every attack of red

or pink eye found in a new-born baby is due to this disease. The stress that the head of the child endures during birth is such that a little redness is by no means an infrequent sequel, and it may be noted in the babies of the most cleanly and virtuous parents.

But whatever the type of inflammation that may appear after birth, whether it appear slight or severe, it should be put under the care of an expert without delay. The words of the warning issued by the Ophthalmological Society of the United Kingdom in 1884 cannot be bettered: 'If the child's eyes become red and swollen or begin to run with matter within a few days after birth, it is to be taken without a day's delay to a doctor. The disease is very dangerous, and, if not treated at once, may destroy the sight of both eyes.'

The disease has now been scheduled under the Infectious Disease (Notification) Act, 1889, and the occurrence of any case has to be notified to the local medical officer of health, who has power to ensure that efficient treatment is carried out.

The matter that escapes from the eyes of the affected infants is highly contagious, and every precaution must be taken to prevent other inmates of the home being affected. Two blind children who came under my care in a blind school had lost their eyes by contamination with the discharges from the eyes of a baby in their home.

In recent years there has been a distinct decline in the incidence of ophthalmia neonatorum, owing to the measures that are taken to prevent it. Since this book may be read by those who spend some of their time in health-visiting and the like, it may be well to set out here the preventive measures against the disease. They are well summed up in the words of Gibson, a Manchester doctor, who wrote in 1807 thus: '(1) The leucorrhœa of the mother ought, if possible, to be cured during pregnancy. (2) When this has not been done, the noxious secretion ought to be removed from the vagina during delivery. (3) The infant's eyes ought, immediately after birth, to be cleansed with a fluid which either removes the noxious matter or is able to prevent its injurious effects.' This was written before the microbic origin of the disease was known, but it gives an admirable summary of the measures necessary to stamp out this cause of blindness.

An inflammation of equal severity, but due to other microbes, may occur as a sequel to an attack of some infantile fever, such as measles or scarlet fever; happily these cases are very rare. They used not to be so in the days before smallpox had been practically stamped out by vaccination. Before this protection was known blindness from smallpox was comparatively common; it is rare now, and the few cases that have come under my care were in unvaccinated children.

In the foregoing, conjunctivitis has been considered as a smart or acute disorder. Some types are chronic and last for years. These are bad types and responsible for much damage to sight. The disease called **Trachoma** is of this order. It is a severe chronic inflammation which affects the inside of the eyelids, making them very rough and coarse, hence the name of the disease, which signifies a roughness. When the lids get into this state the irritation produced on the tender front of the eyeball is severe, and the reaction to that causes the cornea to become bloodshot. If there is no proper treatment the front of the eye may become dull and opaque, so that sight is lost. Trachoma is exceedingly common in the East: MacCallan, who has charge of the ophthalmic hospitals in Egypt, reports that 51 per cent. of the school children in that country are affected by it. It is very common in Eastern Europe, especially in those parts where there are densely crowded city populations—e.g. in the Ghettos. We in England are now comparatively free from the disease, thanks to the special precautions adopted to check the introduction and spread of contagious eye disease amongst school children. It was at one time rife in poor-law schools and asylums, but now there are hospital-schools to which any child that shows signs of inflamed eyes is drafted until it is cured. These are measures that should be insisted upon in the case of all schools, particularly those into which

poor or neglected children are taken, and also in all homes or workshops for girls and young women. The occurrence of trachoma in a charitable institution, or in the young people who have been residents in such institutions, is the gravest reflection on the hygienic arrangements in such places. Nowadays most of the few cases of trachoma that are seen at home hospitals can be traced to charitable schools, residence abroad, or alien emigration.

Trachoma is one of the conditions which render a would-be emigrant to the United States of America inadmissible to that country. The eyes of every emigrant are examined on arrival by experienced doctors, and the slightest sign of the disease causes their rejection. This is a fair indication of the seriousness with which the disease is regarded in the New World. The same care is not taken in this country by our emigration authorities, for in more than one instance I have known a whole family of affected aliens to be admitted to live, work, and even take domestic service amongst us.

CHAPTER IV

EYE-STRAIN

THIS is a term that we hear much of in these days. It means that the eyes are working with some difficulty, so that strain or trouble is caused. The strain may be felt by the owner of the eyes only, but sometimes it is possible for others to see signs of the irritation. The range of effects is very wide: some are peculiar to trouble with the eyes, others are common to eye conditions and to other disorders of the body.

One of the chief signs of eye-strain is to be seen in the face of the child. A worried, strained expression, particularly when it is associated with a perpetual frown, is very frequently due to difficulty with the eyes. It is not natural for a child to frown; if it does there is good reason for finding out why it does so.

Blinking in excess is a very common sign of difficult vision. Things do not appear quite clear, the eyes tend to water too much, and so there is more blinking than usual. This is the state of affairs that may be the start of sore eyelids, so there is

good reason to investigate the eyes of children who are liable to red and tired eyes especially after they have been to the pantomime or picture-show.

From excessive blinking some nervous children pass on to twitchings of the face and brows. Not every case of facial twitching is due to eye trouble, but many are. If this be forgotten, we may waste much time in trying to correct the habits by other and futile means.

There is occasionally associated with the habits of blinking and twitching of the face the bad habit of rubbing the eyes. This is done with marked frequency when the child is tired, or after the eyes have been used for reading and sewing lessons, especially if these be done by artificial light.

Young children, especially when they are first allowed to have picture and reading books, frequently put their little faces very close to the thing that they are looking at. This habit may or may not indicate difficulty in seeing. Children like to see things big, and they get a big image of an object if they get close up to it. This habit, which is a bad one even for those eyes that are perfect in their focus, must be checked, and if it be found to persist it may be taken as an indication that the child cannot see sufficiently clearly without looking closely at the book.

The foregoing are some of the manifest signs of difficulty. They are the most important signs in

dealing with very young children, for in the very young the discovery of defects must be made by the elders; the little ones are not to be expected to tell us what is the matter with them.

There is another class of symptoms referable to difficulty with the eyes: aches and pains. We have to depend on the sensations of the child for our knowledge of them; there may be no outward and visible sign of the trouble to give the mother a hint that the eyes are at fault. Constant headaches are without doubt in a great many cases due to eye-strain, but they may also be due to a variety of causes—general ill-health, indigestion, constipation, bad teeth, febrile conditions, and many other disorders. Persistent headaches should always be taken as a sign that the eyes are possibly at fault and need attention.

The importance of attending to these defects at an early stage cannot be overestimated. Many a quick nervous child, of just that type that is full of ideas and energy, is spoiled by the neglect of some little defect of this sort. Its natural quickness becomes a jumpiness; it is no longer nervous in a good sense, but in a weak, irritable sense; and the energy wherewith it might have done much is dissipated in antics, habit-spasms, and aches, which only serve to aggravate the very conditions that started them. All these forms of irritation are of most importance in organisms that are delicate

and finely balanced, for the more delicate the balance, whether it be of flesh and blood or of steel and brass, the more disturbing are the impressions of even minor shocks. It is held by many, and on good grounds, that these slight but continuous irritations may be held accountable for serious disturbances of mental balance in young children, particularly where by reason of inheritance there is a predisposition to nervous affections.

Next we may inquire what sort of eyes are responsible for eye-strain. Eyes vary considerably. There is no standard eye, only an average eye. A few have perfect eyes, the many very fair eyes, and some have poor or even bad eyes.

The perfect eye is the eye that can see objects in the distance without need for adjustment or focusing; to it is given the elegant Greek name 'emmetropic,' that is to say, it is a 'well turned' or well shaped eye. The majority of eyes are just a little short of the full and perfect focus or length. They are just a little over-turned or flattened, but they do their work with exemplary regularity, provided always that the work is such as they can do.

That last phrase suggests a question. How does the eye work? The work of the eye is one of the most complicated pieces of execution that has ever been conceived. It would be quite impossible for me here to suggest any true picture of the perfection of the association of the eye and the impressions it

receives with the perceiving and translating functions of the brain, and with all those varied movements, expressions, and actions that result from the translation of sight into deed. But we can judge of the effects of sensation and the stresses of muscles within and without the eye.

Light enters the eye, the light produces nervous sensations, and the eyes get tired from the stimulation; even when they are perfect eyes they are liable to fatigue. Again, the eyes are a very sensitive part of the body, so that when the body is tired the eyes are tired. In a very real sense the eyes are the barometer of the body. When we are tired the eyes are likely to feel yet more tired, or we find they get more easily tired than we think they should.

The work of the eye is directly associated with muscular effort. Inside the eye there is a most delicate muscular apparatus. It works all day long, so long as we are awake and have the eyes open. One group of these muscles is within the curtain of the eye. In the middle of the curtain is a hole, called the pupil. The curtain has within its substance two sets of muscles: one that encircles the pupil, and has the work of closing or making small the pupil so as to shut out excessive light; and the other that has the contrary work, that of pulling open the curtain so that the pupil is large to let all possible light into the eye. This work is going on all day long. If it were not for this we should not

be able to see as we stepped from the dimly lighted house into the sunlit street, or passed from the sunshine into the darkness of a building. But with this perfect regulating mechanism we can pass from one to the other with very little sensation of difficulty, except only when the contrasts are intense. The fatigue that is felt when children are taken to the cinematograph show is due to the sudden alternations of light and dark, the perpetual flicker of the moving images, which throws much strain on the mechanism of the eyes, both by stimulating sensation, and by the amount of muscular effort demanded.

Another muscular apparatus has to do with the focusing of the eye. When light enters the eye it is brought to a focus on the sensitive membrane of the retina by means of a lens. That is an arrangement we are familiar with in the photographic camera. In using the camera, unless it be one of the fixed-focus snapshot variety, we are accustomed to adjust the focus for the picture, and we do that by either lengthening the body of the camera or by shifting the position of the lens. The arrangement in the human eye is much neater and more delicate than that; it depends on the alteration of the curvature and thickness of the lens. There is inside the eye a ring of muscles; these act upon a set of fibres that sling the lens all round its edge and keep it taut, very much in the same way that the ropes of a bell-tent keep the canvas taut. When these muscles

are brought into action the tension of the fibres or ligaments attached to the lens is altered, and the lens bulges by reason of its elasticity, so that it is fatter and thicker. The altered shape makes it a more powerful lens, for its focus is shorter.

Focusing is done every time the perfect eye looks at any object that is nearer to it than six yards; beyond that distance the perfect eye can see things clearly without focusing. The eye that is not perfect has to do this work of adjustment of focusing always, not only for near objects, but even for distant objects. Such a state of affairs as this make a very different basis of calculation of work done as between the perfect eye and the defective eye. We can do a great deal of work provided we get decent rests between the several efforts. The heart of every man beats regularly and without difficulty from birth to death, for from forty to eighty years, sixty or seventy times a minute, sleeping and waking, just because it has a momentary rest between each beat. Prevent that momentary rest and the work of the heart will be deranged so seriously that there will be a bad heart attack. It is the same with the eye. The perfect eye can work at reading and other close work for a long time, just because every time it looks away from the work into the distance it is at rest. But the defective eye has to do work at all times both for distant and near objects. It is this that accounts for fatigue and eye-strain in these

children when they are sent to school, and especially when they are not very well, either because of some feverish attack, or because they have been allowed too much dissipation either in sweets or in entertainments the day before.

There is one other form of muscular work that has to be done for the eyes. The muscles that do this part of the work are outside the eyeballs. They are the muscles that turn the eyes this side or that, up or down, and, hardest work of all, turn them both inwards towards the middle line as when we desire to look at something that is near to us. This last piece of work is particularly fatiguing. Any one can demonstrate the effort on his own person; the attempt to look at the end of one's nose will surely cause a pain in the eyes, and that pain is caused by excessive effort. That is one of the reasons why it is essential that children should be taught to sit well away from their work and books.

So far all these several actions have been spoken of separately, as though they took place at different times. That is not so. They are performed all together, at one and the same moment; and the necessity for the perfect association of all these efforts calls for the expenditure of further nervous energy and therewith more possibility of fatigue. When that association is made difficult, from defects in the focus of the eyes, then the fatigue is disproportionately great and positive pain will be caused.

There is one other way in which work is done in the eye. Pigment is necessary to sight. When light enters the eye the pigment or 'visual purple' is bleached; it undergoes changes just as the chemicals in the photographic plate. Continued exposure to light exhausts the visual purple, but during sleep the pigment is restored. This points to the necessity for sleeping in the dark. The child's night nursery should have blinds that will make it sufficiently dark in the early hours of the summer mornings. Louvre shutters outside the windows will do this without any interference with free ventilation. The old idea that it was bad to sleep in the rays of the moon had just this much basis of fact; exhausted travellers sleeping exposed to the rays of the moon had their eye pigments stimulated and wasted even when they were asleep, so the eyes were doubly exhausted and the sight injured.

CHAPTER V

FLAT EYE: ASTIGMATISM

FULLY eighty per cent. of the population have eyes that show some deviation from the normal. When the difference is small and there is not much close work it may cause no trouble at all; indeed, some have even argued that a small degree of flat eye is an advantage!

The commonest of these deviations is that known as hypermetropia. The eyeball has not grown to

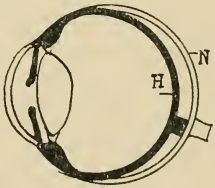


FIG. 8.
H, flat eye; *N*, normal eye.

the full size, it is too flat. Such an eye as this cannot see into the distance without the necessity for some focusing of the lens of the eye; and when it is necessary to look at things close at hand there is

double work to be done, for the ordinary near adjustment must be made, and in addition just so much extra adjustment as the eyes are flat. This extra may be very little, but it tells when added up in terms of work through a whole day. Some eyes are much flatter than others, then the defect is serious; there is the difficulty of focusing and the difficulty of working the two eyes together, so that squint may be caused.

If the children with the flat eyeballs were always out in the fields, running and playing, they would not experience these fatigue effects, except in the few extreme cases. But when we put them to books they are liable to suffer. For these children glasses are needed. They may not be wanted to make them see better, but they are needed to prevent the eyes getting tired. Many only need the glasses for near work; they can do without them safely when they are at play, or on holiday; but if we wish to prevent eye-strain, glasses they must have.

There is another cause of difficult vision. It comes next in frequency to flat eye, and it not only causes fatigue, but it also makes the vision poor or even bad. This condition is called 'astigmatism.' The word means 'that which has no point,' and it indicates that there are eyes that have no focus—that is, they are so shaped that it is impossible for the eye to get a perfect focus under any circumstances. This defect arises from an irregular curvature of

the front of the eye; the clear cornea is not perfect in its curves, so that it distorts the rays of light that

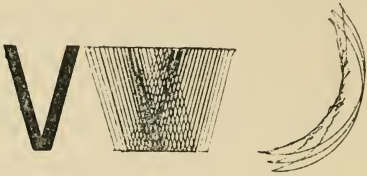


FIG. 9.—ASTIGMATIC EFFECTS.

V is seen as W; the crescent moon has many horns.

pass through it to enter the eye. When we were children we have all been puzzled at the weird shapes our faces and hands took when viewed in the mirror of the sides of the silver teapot; and maybe we have seen some comic mirrors that reflected the face 'before and after dinner': these are all astigmatic effects.

When there is astigmatism there is almost certain to be eye-strain sooner or later. The time of the trouble will depend on the nature and health of the child, and on the character of the school-work it is put to. If the health be poor, and if the school-work be heavy, the complaint of trouble will be made early. Similarly when the child is of a high-strung, nervous temperament there will be early complaint, and in these cases the effects of the strain may appear altogether disproportionate to the degree of the astigmatism.

The reason for the trouble is as follows. When there is a small degree of this sort of defect vision may be good—that is, the child may be able to read the standard distance sight-test quite well; but the very act of reading makes the child unconsciously aware that the perception of the letters is not all that it might be. This leads the focusing muscles of the eye to try to get a better focus, and since this cannot be obtained there is a continuance of unavailing effort, and fatigue is induced by ordinary reading much more easily than it should be. The same happens when there is such a degree of astigmatism as will cause the child to fail to read the last line or two of the test; then the trouble is likely to be marked, and headaches, frowning, and the like will be evident, even before the child is taught to read. Curiously enough there is often no complaint at all when the astigmatism is of high degree; the child does not see well, and the only abnormal thing to be noticed about the child will be the habit of holding things close to the eye; it may escape all headaches, its little brow may never show a frown, and it may never develop the blinking habit or an ugly twitch. This seems a puzzle at the first glance, but the explanation is simple. When the degree of astigmatism is high the eyes recognize, unconsciously to the subject, that it is quite hopeless to attempt to focus objects that are so distorted, so that none of that futile work is attempted which

causes so much discomfort when the astigmatism is of low degree.

The foregoing facts all point to one conclusion: that the eyes of every child should be examined before it is put to school-work. This has become the regular practice of many of the more enlightened educational authorities of the world. It is being adopted in many private and public schools; and there can be no doubt of the benefit that would accrue from its universal adoption. Nothing is more distressing than the experience of parents, teachers, and child, when, as is by no means infrequent, a smart, well-set-up youth, who has been carefully prepared for some competitive examination—say, for entry into the Navy—meets with his first failure at the hands of the examining doctor: he is failed for defective eyesight. If his eyes had been examined earlier in his career the defect would have been known, his school-work would have been altered accordingly, and the disappointment of the rejection avoided. It is even possible that the knowledge of a small eye defect in the early years might have prevented the increase of the defect, for the proverbial stitch in time applies as much to the eyes as to one's clothes.

The frequency of eye defect shows how important is a routine examination of the eyes. In one good-class school I examined the eyes of all the boys and girls. 341 boys and 328 girls were examined. Of

the girls 74 per cent. had good vision and 26 per cent. failed; of the boys 82 per cent. had good vision and 18 per cent. failed.

In 1913 I examined the returns of the patients at my children's hospital. 1670 children were seen on account of bad eyes; 1348 had eyes with bad focus so that they could not see properly.

The kinds of errors of focus found in the eyes of these children were as follows:—

Defect.	Number.	Per cent.
Flat eye or hypermetropia, . .	349	25·9
Astigmatism of all sorts except myopic, ...	655	48·7
Myopia or short sight, . . .	167	12·4
Myopia with astigmatism, . .	177	13·0

Ill-health has a marked effect upon the eyes. The eyes are the barometers of the body. It is quite a common thing for a mother to date the onset of a squint in her child's eyes from an illness. It is not the fever itself that causes the defect, but the poison of the fever sets up a state which may be likened to excessive exhaustion, and the eyes fail under the added stress. This points to the necessity for special care in the use of the eyes during and after illness. Generally it is just the other way about; the sick child has unlimited books given to it. Then when the child is convalescent more and more books are

showered upon it by indulgent parents, and the muscles of the eyes which are already suffering from the effects of the poison are further strained by the continuous reading. Not a few cases of short sight date from the occurrence of an illness. Better by far give the child a box of paints and let it draw, or a box of plasticine and let it model, or if the little patient be old enough give it wood and a penknife and let it carve; the risk of eye-strain with any of these materials is far less than with books.

Smoking by boys has only to be mentioned to receive the reprobation of all. There are definite ill effects known to be due to the smoking of cheap cigarettes. The attention of the child tends to wander from the work in hand, there is a general listlessness, the handwriting becomes unsteady, the lines of the writing are crooked, and the words are ill-formed and quavering in outline like the work of an old man. Cessation of the bad habit and tonic treatment brings a return of stability.

CHAPTER VI

SHORT SIGHT

THE short-sighted child is able to see the finest details of objects which are held close to its eyes, but it cannot see the leaves on the trees, the details of the landscape, the beauty of the work of the public buildings, or even the features of the face of a friend. Everything beyond a certain distance is in a fog or blur. Yet the child knows that there are things to be seen, for by screwing up the eyes details can be made out that are invisible when the eyes are wide open. It is this habit of screwing up the muscles of the eyelids that gives the name to the condition. Proper short sight is known as 'Myopia,' a term derived from a Greek word that means 'to shut the eyes.' The eyelids are screwed up to convert them into pinhole cameras like the eyes of the pearly nautilus, mentioned in Chapter I.

There is a popular idea that short sight is strong sight. It is the very reverse. The idea rests on certain observations. Short-sighted people are commonly able to read very fine print close to their eyes; also moderately short-sighted adults do not

have to take to reading-glasses at the age natural to folk with healthy eyes. These two observations are true in point of fact, but neither establish the strength of the sight; they merely demonstrate the shortness of the sight.

In short sight the shape of the eyeball is altered. Instead of the globe of the eye being spherical, it

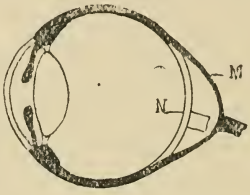


FIG. 10.
M, stretched myopic eye; *N*, normal eye.

has become elongated, inclining to a sausage shape. The elongation is not a natural condition like the short or flattened eye. The flat eye is born, not made. The elongation is the result of a gradual yielding of the coats of the eyeball. This yielding is the bad thing; it indicates an inability to resist the ordinary internal pressure of the eye, or the ordinary strains exerted on the eye in the process of vision. The yielding is a disease. The coats of the eye that yield are in a state of low-grade inflammation, and being inflamed they are soft and yield to strain exerted either from within or from without the eye. It is no mere 'state,' it is a process, and one that is changing in nearly every short-sighted

eye during school years. Short sight is never, or hardly ever, present at birth. It is rare at five years of age. It usually begins during school life, and increases more or less from year to year during the period of growth. It sometimes continues to increase after growth is completed.

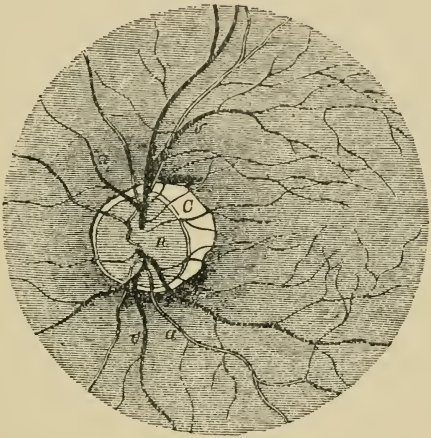


FIG. 11.—BACK OF SHORT-SIGHTED EYE.

n, nerve; *a*, artery; *v*, vein; *C*, crescent where the soft coats of the eye have torn away from the nerve exposing the white outside coat.

In the past few years much attention has been given to the anatomical changes involved in near work; various theories have been formulated, and some experimental work done in support of these. Stress is laid on near work that involves the *stooping posture*. One German oculist has gone so far as to

assert that the elongation of the eye is caused by the drag of the optic nerve on the back of the eyeball, for in the stooping posture, he asserts, the eye falls forward by virtue of its own weight. Personally I do not credit the idea, but rather favour the theory that it is largely the effect of the active constriction of the eyeball by the muscles surrounding it, and that come into play for the purpose of turning the eyes inwards and downwards during near vision. Be the actual process what it may, the effects of near vision and the stooping posture are the factors we must fix our minds on, particularly when we have to consider the work that may be done by myopic children.

The frequency with which myopia is met with amongst children differs considerably in different countries, and in different parts of the same country. The first estimates of the incidence of the defect were made by Cohn in Germany, and the report which he gave was alarming. Amongst the children attending the gymnasia or higher schools he found the percentage exceedingly high, and increasing from the lowest classes to the highest. The figures varied from 15·5 per cent. in the lowest class to 55·8 per cent. in the highest. These figures were serious, and called for a thorough overhauling of the educational system under which it occurred. That was the judgment of Germany, and in that land no pains have been spared to improve school

conditions, and so far as possible reduce the causes of the short sight.

In this country the figures are much better. I have published the returns of 2500 London school children who had bad vision: 68 per cent. were hypermetropic and 32 per cent. myopic. Roughly, 30 per cent. of the children who failed to pass the standard vision-test failed because they were short-sighted. These defective children represent about 10 per cent. of the school population, so that it follows some 3 per cent. of the children are myopic.

But it must not be supposed that these myopes were evenly distributed throughout the whole 2500 children examined, so many for each age group. When the cases were plotted down according to the ages of the children it was found that there were very few short-sighted children in the younger years, but a steady increase right through the school years up to the leaving age. Here are the percentages :—

Age in years,	4	5	6	7	8	9	10	11	12	13	14	
Myopia per cent.,	0	2	8	12	20	24	33	40	49	52	65	per cent.

That return shows very well the character of the myopia ; it comes on during school life, and increases in frequency and in degree with each year of school age.

There are two sorts of myopia. There is, first, a large group of cases of moderate myopia. These may be called the school myopes. They are probably the astigmatic children who, by reason of excessive

work, or work under bad conditions, have become myopic. This class of case is a reflection on the methods of education in vogue, and on the current print of schoolbooks.

The other class is numerically small, but the degree of myopia may be high. In this group are most of the hereditary cases, children of myopic families. These are the dangerous cases, for amongst them we are likely to find sooner or later some tendency to complications which may endanger sight. Opacities of the vitreous jelly of the eye, *muscæ volitantes*, or floating spots of irregular shape, are very common occurrences. Small floaters may be present in even low degrees of myopia and in quite young children; but spots so large that they may be seen by the surgeon with the ophthalmoscope are ominous. The stretched eyes are more delicate than ordinary, so that relatively slight injuries may produce serious changes. The subjects of myopia of any degree are more liable to eye-strain than ordinary children; so they often exhibit 'weak' eyes which are the outward signs of the eye-strain.

The part played by heredity in the production of myopia may very well be considered here. There is no one who is not thoroughly convinced of the truth of the inheritance of family characters. Each child of a family has been subject to scrutiny on this score. If we recognize features, characters, and tricks of mannerism that are pleasing, then we

are quite sure that those characters came through our side of the family tree; if those same tricks or features are not attractive, then no doubt they are the result of a throw-back to a branch that we remember most to forget! As with general characters so with particular characters; and the eyes are no exception to the rule. Indeed, the knowledge of the hereditary characters of particular eye states is more complete than for any other character of the body. Workers on heredity have been able to follow out eye peculiarities better than any other, for they do not interfere with the possibility of continuance of the family; often they do not interfere with health, and they are sufficiently marked to be remembered by relatives even when the distant forbears have departed. Congenital or birth cataract is a character of this type, so is colour-blindness, and there are numerous pedigrees of these, and other defects, running through many generations, which clearly prove the inheritance of family characters in the eyes.

As regards myopia the case is not so simple. There may be an inherited predisposition to the stretching of the eyes. But if it be true, and of this there is no manner of doubt, that defective school conditions, or ill-health, may induce this same stretching in the eye of the young child, then the case is complicated. For all that, there can be no doubt that myopia is very common in some families, and comparatively rare or even unknown in others.

Recently I collected the case papers of 300 highly myopic children for comparison, and of these 50 cases showed a definite family history of myopia—that is, nearly 17 per cent.

Again, astigmatism is unduly common in myopes; it is responsible for eye-strain, and therefore may be the start of myopia. In 300 highly myopic children no less than 158, or 53 per cent., had marked astigmatism, or nearly 10 per cent. more than the average percentage in children with bad focus. Astigmatism is due to the shape of the eye; it is hereditary, and in certain conditions may predispose to short sight.

One other factor in the causation of myopia must be considered. There is no doubt that health has much influence on the state of the eyes. A robust child, well fed, enjoying a maximum of outdoor life, is less likely to get tired eyes and subsequent stretching of the coats of the eyeball and myopia than is a child that is cooped up indoors all day, sitting over lessons, and never joining in vigorous outdoor games. The figures given of the incidence of myopia show that we in this country are less liable to the condition than some continental nations. Part of this difference may be due to the different reading types: the gothic type of Germany is particularly difficult to read, and certainly engenders eye-strain in even normal eyes. But this is not the only factor, for in countries where this type is not used

there is also an excess of short sight. Opinion is growing amongst oculists in those countries that the excess is in part due to the lack of vigorous outdoor sports during school years, and efforts are being made to stimulate the popularity of games such as are played by all sections of our own community.

The education of short-sighted children presents some difficulties. In London there have been established special classes for the short-sighted children of the elementary schools. These bid fair to be a success; already they are being copied extensively both at home and abroad. The principle underlying the scheme of education adopted in these classes is very simple; it is a return to the primitive methods such as must have existed amongst our woad-tinted forbears, when the wise one of the tribe taught the traditions of the fathers to the children, initiated them in the secrets of their cunning handiworks, and showed them how to make the tribal marks upon the walls of their huts and caves. There, in brief, is the scheme of the myope class: it is essentially personal, and lacking in that modern substitute for personal teaching, the book.

The scheme of work laid down for these classes is as follows:—

(1) Oral teaching with the normal children for such subjects as can be taught orally.

(2) Literary work, such as is necessary for the knowledge of the ordinary means of communication,

to be learned without the use of books, pens, or paper, but by the use of blackboard and chalk, the writing to be done free-arm fashion.

(3) A very full use of every sort of handicraft that will develop attention, method, and skill, with the minimum use of the eyes.

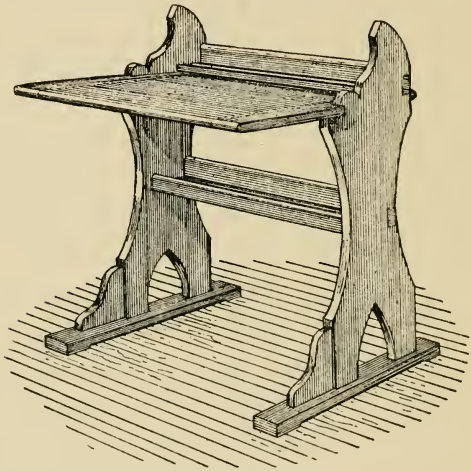


FIG. 12.—THE AUTHOR'S MYOPE DESK, IN USE AS TABLE.
(*Hammer and Co., Charing Cross.*)

These classes have now been working for some seven years; the eyes of the children admitted to them have been the subject of regular periodic examination, and it is found that their state is benefited by the manner of work. The method is attractive both to teachers and scholars, notwith-

standing that the teachers must exert a degree of alertness that is not the rule in ordinary teaching. The teachers have to do real teaching. They can no longer set a task from a book; they have to give out that which they know and which is part of themselves. The children benefit proportionately, for there is a

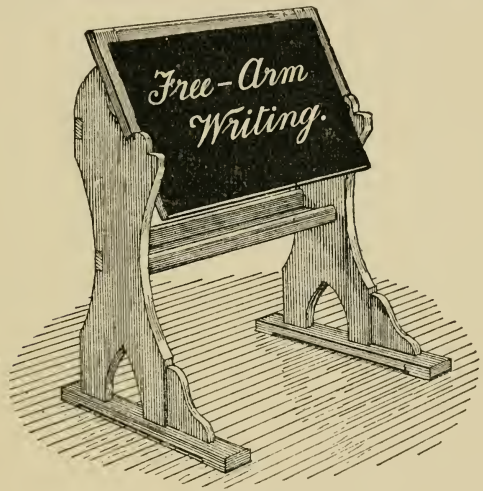


FIG. 13.—THE AUTHOR'S MYOPE DESK, IN USE AS BLACKBOARD.

personal impression that can never be gained by the use of a book, however excellent that may be.

The room in which this work is done must have perfect natural light, and when that fails all blackboard or manual work should cease, and drill or conversation be substituted. The numbers in a class must be small; twelve is the optimum number.

The hours should be short, and the periods of work broken by frequent intervals. The teacher should teach, then the children should write what they have learned in large hand upon their own blackboards. or print them with type on sheets of paper hung on the walls. Drill, games, and dancing may be enjoyed by most of these children, but there are some whose eyes are so fragile that the greatest care must be exercised, or the pleasure of some of these things denied them. Manual work is dealt with in Chapter XII.

The whole scheme of these classes is set out in a paper that may be consulted by those interested.[1]

[1] Harman, 'The Education of High Myopes,' *Proceedings Royal Society of Medicine*, 1913. Vol. vi., Ophthalmology, pp. 146-63.

CHAPTER VII

SQUINT

SQUINT is the disorganization of the mechanism which works the two eyes together; there is with its onset a total loss of that most perfect and valuable of all the functions of the human eyes—binocular or stereoscopic vision.

The frequency with which squint appears amongst children can be best judged by examining the figures of my children's hospital. Of 1400 children examined for bad focus no less than 199 had been brought on account of squint; all the younger children seen were squinters.

Age . .	4	5	6	7	8	9	10	11	12	13	14
Per cent. .	100	100	63·2	32	7·6	17·7	5·5	5·2	7·5	2·7	5·4

The great majority were of the fixed type with one eye turned inwards: this is called convergent squint; when one eye turns out it is spoken of as a divergent squint.

The ugliness of squint is patent to every one. It is probable that the 'evil eye,' for which many hapless old women were harried to their death on the sus-

picion of witchcraft in 'the good old days,' was no more than a common squint, a 'cast' in the eye, or 'bossing,' as it is called in many parts of the country to this day. And bossing has an evil significance; of persons it indicated a despicable and worthless character, usually of decrepit age. 'I speak to you, auld Bossis of perditioun,' Lyndsay, *Works* (ed. 1592). Not only was squint thought to have evil significance, and truly it caused the unfortunate subject thereof many pains at the hands of others, but the defect itself was considered to be the work of evil spirits. In *King Lear* we find the following in the scene on the heath at night: 'This is the foul fiend Flibbertigibbet: he begins at curfew, and walks till the first cock; he gives the web and the pin, squints the eye, and makes the hare-lip; mildews the white wheat, and hurts the poor creature of the earth.'

In nearer times than those in which Shakespeare wrote, a squint has been the cause of slanderous accusations against quite harmless individuals; in rural districts the squinter has been proverbially a thief, somewhat after the kind of Taffy in the children's rhyme. There is even something of this feeling still existent to-day, and in more than one case a man in business has desired to have the deformity of squint corrected by operation, 'because he found that people with whom he had dealings seemed to doubt his probity when they noticed the squint!'

In its essence squint is a falling back into a lower

state of organization, so far as the eyes are concerned. Instead of the 'eyes right' direct look of the man, we get the irregular fixation of the eyes normal to the lower animals. Monocular vision is the normal condition of the lower vertebrates. Who has not seen the movements of the eyes of a chameleon? One eye of the creature has been awake when the other was lowered as if asleep, or one has looked forwards whilst the other seemed to look backwards. But that obvious absence of association of the two eyes is no more remarkable than the regular lateral position of the eyes in fishes. Their eyes can by no means work together, for they are set on the opposite sides of the head. When we examine the anatomy of the nerves of the fish we find that there are two distinct optic nerves that run quite independently to the two sides of the brain, and there is no connexion between them. It is quite otherwise with the eye-nerves of man; the two great eye-nerves meet inside the skull, and join in such a fashion that half the nerve of one eye unites with the corresponding half of the nerve of the other eye; so that the brain receives the joint impression of the two images the eyes have gained of the one object looked at. In the fishes a complex arrangement would be no use; their eyes are more in the nature of alarums than organs of perception, for they have other senses wherewith to find their food and detect their foes.

The same holds good for the lower mammalia, e.g.

the rabbits. In these animals it is obvious that so fine a faculty as binocular vision would be wasted, for their visual perception is practically limited to moving objects. At the least sign of movement in the surrounding objects they are alert and run; whereas if a man will remain quite motionless the rabbits will go on feeding all unconscious of his near presence, provided the wind be in a favourable direction.

There appears to be some attempt at two-eyed vision in the higher hunting mammalia. The domestic cat seems to have some such power, for it is noticeable that the eyes work together in examining near objects, and that a cat is able to 'handle' an object with great nicety, much more so than can the dog. With this development of the eyes in the hunting animals there is a large increase in the area on the surface of the brain where is all the active grey matter which belongs to the sense of sight. This area is small in the hunted animals, but large in the hunting animals.

In man the development is complete. The whole of his face and the position of his body has been remodelled to secure this great object. Man stands erect to the view; his face is flattened so that the eyes may come well to the front, in which position alone can they work together; and the snout has gone, and with it some of the keen sense of smell that belongs to the lower animals. Man's eyes now work

on parallel axes, and they can be turned in towards each other so as jointly to examine near objects.

FIG. 14.—NO SQUINT: 'EYES RIGHT.'

There is now constant association of the two eyes, and this gives binocular vision, and with that the ability to determine the size, the bulk, and the distance of any object. This judgment is effected by

FIG. 15.—SQUINT: RIGHT EYE TURNED IN.

an unconscious, but trained, perception of the nerve impulses required by the muscles of the eyeballs in moving the eyes from one position to the other, as a

FIG. 16.—SQUINT: RIGHT EYE TURNED OUT.

man looks first at one and then at another object. Binocular vision is something that the unfortunate

person who has not the faculty cannot understand; he therefore cannot be brought to realize what is missed. It is something like colour vision: to the normal person red is a glorious colour, to the colour-blind it is no more than drab, and no power can enable such a person to understand the raptures of the artistic over fine colour effects. So it is with tone-deafness.

With the growth of this power of the eyes, there has been a corresponding development of the brain in the area where the visual centres are situated. In man these occupy an enormous area as compared with the hunted animals, and even when compared with the areas of the hunting animals. Man is therefore easily first as the 'mighty hunter before the Lord.' If it were not for this great cerebral development there never could have been that perfect association of hand and eye that make the artificer, the artist, and the musician.

The brain is the real factor in the production and maintenance of binocular vision. It is the brain that keeps the eye in control. This control goes by the name of the 'fusion faculty'; the term indicates the power of the brain to fuse into one satisfactory picture the two divers images seen by the two eyes. When we look out of the window the two eyes do not see exactly the same view, for they are differently related in point of space to each other. The right eye is somewhat to the right, and therefore gets a

wider view beyond the left-hand side of the window frame; the left eye is situated rather to the left, and gets a better view towards the right side. The width between the two eyes is not great, no more than four inches in the most widely set eyes, but that little difference makes all the difference to the impression that is received by the eyes. The two slightly diverse images are telegraphed up to the brain by the nerve currents, the cells of the grey matter of the brain fuse them together or overlap the two impressions so that they become one, and the slight difference of the two impressions gives all that feeling of solidity that we perceive in the view, whether it be of trees, of statuary, or of persons.

Binocular vision is not present at birth. It comes into play about the third or fourth week of life; but then it is weak and tottering, and just as uncertain as a child beginning to walk. A very little irritation, even a pin-prick, will cause the eyes to squint. Pain, the convulsions of indigestion, the irritation of worms, all will set up a squint of temporary or permanent character.

The observation of the ease with which squint may be induced is very old. Bacon writes: 'Some can squint when they will; and children set upon a table with a candle behind them, both eyes will move outwards, to seek the light, and so induce squinting.' A very similar warning is to be heard even nowadays in many nurseries: the elder children are forbidden

to look at the baby from over the head of the cradle, lest the baby in trying to see them should develop a squint. There is an even more interesting observation in the famous Diary of Pepys. He writes: 'At supper the three doctors of physic again in my cabin, when I put Dr. Scarborough in mind of what I heard him say: that children do, in every day's experience, look several ways with both eyes, till custom teaches them otherwise; and that we do now see but with one eye, our eyes looking in parallel lines.'

Once binocular vision is established it is rarely disturbed, but should the control of the brain be weak, a very little irregularity of one or both eyes will cause a squint to appear.

The state of the case may be illustrated by a simile. The relation between the two eyes, the muscles of the eyes, the nerves that stimulate the muscles, and the brain that controls the nerves, is very like that between the horses, the traces, the reins and the driver of a four-in-hand. A good driver will master a bad team. If the driver be bad, even though the team be perfectly matched and the equipment all that could be desired, the fool of a driver will surely run the coach into the ditch at the first bad turn in the road. So with the eyes. There may be an ill-matched pair of eyes, the focus of one or both may be bad, but if there be perfect brain control there will be no squint, however adverse the conditions may be,

but there will certainly be all the symptoms of eye-strain. On the other hand, there may be a perfectly matched pair of eyes, and with an equipment that is perfect so far as can be determined, yet if there be an imperfect brain control, then at the least difficulty there will be 'an overturning of the coach,' the eyes will squint. If the baby be young, a prin-prick or the worms will do it. When it is older a mild fever will do it. When it goes to school the first turn of close work will do it. Each of these things is debited with the disaster, but really the fault was with the brain.

This is an extreme case: there are some such, but happily not many. For the most part squints appear in those who have some defect in the focus of the eyes; there is some brain control, but it is not so strong as to be able to keep the eyes together when the circumstances are adverse also. When there is the prin-prick, or the worms, or the fever, or the lessons at school, then the added strain thrown on the brain makes the work too much for it; it ceases to control the unequal eyes, so that one squints. Squinters rarely or never complain of eye-strain when the squint is established; they have given up the struggle.

It is obvious from the foregoing that it is very important to check the squint at its very onset. For it means the cessation of a very important piece of brain-work, one that has taken æons of time to weld

into the brain fibre of man, and the loss of which is something that cannot be measured in vulgar fractions.

There is, however, another reason for dealing with a squint at the earliest possible date. And this is a reason that is easier to understand than the foregoing. When an eye is turned so that it continually looks in a different direction to the other, the sight of the turned or squinting eye is lost. The eye sees nothing. That this should be so is an obvious necessity. If it were otherwise the child would be for ever seeing two objects, two steps, two doors, and the confusion would be distressing and possibly endanger its life. With a child the connexions of the nerves of sight are so lightly joined that the double vision produced by squint may be lost in an hour or so; indeed, it is rare to hear of any record of such a difficulty from the parents or nurses of these children, except when the squint is of sudden onset, as in the case of accidents, falls, and the like.

If a squint be neglected the squinting eye may become completely blind for all the finer purposes of the eye. It will no longer be able to see letters or recognize faces, it may even lose the power of turning so as to fix its axis on the spot that the owner wishes to look at. Such a change as this in an eye means the loss of the eye to all intents and purposes, and it is a serious thing to begin life with such a handicap. It is a handicap that makes it impossible

for the child in later years to enter most of the public services.

When a squint is noticed the child should be taken at once to a doctor who has skill in eye-work. His first care will be to examine the focus of the eyes, for if this be bad there must be difficulty in keeping them under control. The correction of these difficulties by the means of suitable glasses will in many cases relieve the squint, and the eyes will come straight again. Everything depends on getting the child early, before the binocular faculty has withered from disuse, and before the sight of the eye has been lost by suppression. We are familiar with the effects of disuse of the limbs after a long illness in bed, or we have seen the pictures of the Indian fakir with an arm shrivelled and powerless from years of disuse. It is just the same with the squinting eye, even though by the minutest examination we cannot detect any visible sign of this withering. But if we get the case early we can revive all the benumbed and sleeping faculties, and get them back into full work again.

If the squint has existed for some time the eye doctor will try to wake up the sleepy, squinting eye, by using a form of stereoscope; by covering the good eye for three or four weeks so as to make the other do all the work; or by putting some belladonna into the good eye every day to prevent that eye seeing near objects. All the methods depend for their

success on an early start; if several years have passed it may be impossible to reawaken the benumbed sight of the eye.

Operation will cure squint. It is the only method whereby we can get rid of the deformity when it has persisted for several years. And it is the way to cure squint when we find that we can both revive the sight of the turned eye to a sufficient degree, and awaken the dormant binocular brain centres: putting the eyes straight by operation will allow the brain once more to assume control, and binocular vision may be restored. A fixed squint is like an obstacle to the brain. We may correct the bad focus of the eyes by glasses, awaken the sleepy eye and the binocular brain centres, but yet fail to get rid of the squint. The obstacle arises in this fashion. When there is a marked squint the muscles of the eye are altered; some stretch, others shrink, and they get fixed in this condition just like a crooked tree, then the brain cannot regain control, and we can only get the eyes to work together again by readjusting the tendons. We shorten the stretched tendon and lengthen the shrunken one. To-day these operations are among the neatest and most perfect of surgical measures, and as far removed as can be from the crude operations with which squint was first straightened. The operation can be compared with the adjustment of a bell-tent: when the pole is not set straight the whole tent is lopsided, we therefore tighten one set of the

tent ropes and loosen another until the pole is straight. The old-time practice of cutting the shrunken tendon has been abandoned, for it slackened the attachment of the eye, and involved the risk of a squint in the other direction in later years.

There is a popular idea that children grow out of squints. There is some truth in this idea. Many a very young child has been seen to squint for a few days when it is ill. Irritation may make it squint, and when that irritation is withdrawn it will cease to squint; these are only temporary cases. Then there are children who grow up with a squint, and when they are well on through their teens, at the time of puberty, the eyes of a few of them will get straighter, or almost straight, and the squint will only be noticed when they are tired, and in the evening. The temporary squint of the young child does no harm. But it is a warning to the parents that it probably has a weak brain control over the eye, so they should be watchful to see that it is not overworked in its early years at school. The case of the children who grow up with the squint is different. Even though their eyes should come straight they never lose the effects of the squint. They have lost their precious faculty of binocular vision, and the sight of the eye that was crossed is lost for all practical purposes.

Squint is very frequently seen in families for several generations. A weakness of brain control,

or a bad focus of the eyes may be inherited; either may precipitate squint when other circumstances are favourable. The squint itself is not inherited, only the conditions that favour its onset. It follows that parents who know of the liability to squint in one or other side of their pedigree should exercise great care when the children first go to school. There should be no reading or writing when they are ill, and no home lessons at any time. Further, it is well to have their eyes examined early in case there should be a bad focus to the eyes.

Occasional squint is a matter that must be referred to. This is most frequently seen in girls. During the day they look with both eyes straight forwards, but when they are excited or tired, especially after an evening party, or when they are not quite well, one eye is seen to turn outwards. They are quite unconscious of the turning, for the sight of the squinting eye is suppressed, but when they are told of it the eye is promptly brought back to its duties again. This is due to weakness of the brain control. The brain is able under most circumstances to keep the eyes in order, but when there is excitement or fatigue it gives up work for a moment and the eyes turn out. We have all experienced something like this when in a 'brown study' things seemed to double; that was because we were not paying attention, and there was no definite object on which the brain could balance the eyes. There is another condition that

produces this occasional squint. In some children the muscles of the eyes are not accurately balanced, so that use of the eyes easily causes fatigue of the controlling mechanism. It is like driving a four-in-hand with badly adjusted reins; the driver soon gets tired of the unequal strain. If then the control be naturally a trifle below the standard, with the onset of fatigue there will be temporary loss of control. In any of these cases of temporary squint it is necessary for the eyes to be examined by the doctor; there may be some error in the focus or some defect in the balance of the muscles. The correction of either of these will help the eyes and the controlling centres; also it is possible in some cases to institute a series of exercises which will strengthen the control.

CHAPTER VIII

SPECTACLES

SPECTACLES were once so rare as to be bequeathed in last wills and testaments as heirlooms. Now the use of glasses is so common as to pass unremarked.

Glasses are indispensable for some children, but even so they are a nuisance. No one can suggest that they improve the looks of a child. Yet they must be worn by some children lest a worse thing befall them. It is a choice of evils, and when that choice is between the wearing of a pair of spectacles and the continuance of headaches, facial antics, or any other of the host of fatigues and disabilities, there can be no question that it is better to have the glasses than to have the pains. In many cases there is the possibility that a pair of spectacles may be like the proverbial 'stitch in time,' and the timely wearing of glasses may enable the child to do without them at a later date, even perhaps for many years.

One caution must be given. There are many who profess the necessary skill to 'test the eyes scientifically.' We see these words, or others like them, on

many shop windows; and those who so advertise their capability are accustomed to add to their names mysterious letters which represent the initial letters of the trade societies to which they belong. This is a free country. There is nothing to prevent any one claiming any skill that he thinks he has. The books we doctors write are open to any one to read, and to understand if they will, and it may be that some of those who hold out these advertisements of skill have learned the lessons of these books of ours so far as it is possible to learn by book and not by hospital experience. But for those who have the care of children and who value the eyes of their charges, it will be wiser and safer to submit the eyes of their children to the examination of an ophthalmic surgeon whose training and experience will stand them in good stead. It must ever be borne in mind that the eyes are not mere optical instruments, but in very truth members of the body, sharing in all the difficulties and distresses of the body. It is by no means infrequent that the eye surgeon sees first in the eyes those signs of danger that are a warning to the physician, and an indication for his treatment. The knowledge of the eye cannot stand apart from the knowledge of the body, and he who would be an expert in the treatment of one member of the body must first be a master of the art and craft of the physician.

The work of the optician is of the utmost value.

We look to him to prepare the lenses and frames that are necessary for the child; he has the skill of grinding the curvature of the glasses to the prescribed degree, and the capability of making metals into convenient and comfortable frames. But his work begins and ends there. To expect him to 'test the eyes scientifically' would be like expecting the oil and colourman to be an artist just because he has skill in stretching canvases and mixing paints; we know he can prepare paints, he might by chance be an artist of no mean skill, but we do not go to him for academy pictures.

Lastly. It is very frequently necessary in examining young children to put drops or ointment into the eyes so that a true judgment may be made of the condition of the eyes. These preparations are derived from the plant called *belladonna atropina*; in the hands of a doctor they are safe, harmless, and necessary; they should not, and indeed they are not, used by any one but a doctor. The necessity for the use of the drug is accounted for as follows: the focusing muscles of a young child are very active, the focusing lens is very elastic; between the two the range of focusing power is very great. It is therefore not possible in most cases to obtain a true judgment of the focus of the eye unless this activity be temporarily quieted by the use of a belladonna preparation. When that is used the pupil of the eye dilates, and the internal focusing muscle goes to sleep, then the

true state of the vision can be determined. When that has been done the belladonna is allowed to pass off, or is driven out by the use of another extract. When this procedure is not followed there is grave danger in mistaking the focus of the child's eyes—it may even be thought to be short-sighted when it is not; and if this be done glasses to correct short sight may be ordered and the initial condition of eye-strain aggravated, or the child may even be made short-sighted by the wearing of the wrong sort of glasses.

When glasses are worn the parent should be sure that they are straight on the face, that the fit is such

FIG. 17.—THE AUTHOR'S MODE OF FASTENING GLASSES ON INFANTS.

that the little nose and ears are not cut by the frames, and in many cases it is better to have a second pair for use in case of damage to the first.

Occasionally spectacles have to be worn by very

small children, or in case of squint even by infants, then there may be some difficulty in fastening the frames on comfortably and yet securely. The drawing in Fig. 17 shows a very simple and satisfactory way of securing the glasses, and one that will quite prevent unpleasant pressure effects.

There is very little danger of injury to the face or eye by the breaking of glasses. Accidents arising out of their use are very rare; and when the number of glasses worn are considered, accidents are so rare that one may say that the risk is altogether negligible.

CHAPTER IX

LIGHTING

THAT light is necessary to sight is a truism. But to say that proper light is necessary to good sight is to state a fact that is more honoured in the breach than in the observance. To-day in our cities there is more light than has ever been known since the world began; night is turned into day, and the eyes suffer from over-stimulation. It is bad for the elders, it is worse for the children. The production of high-power lighting effects have added to the apparent attraction of streets, halls, and shops, but the manner in which these effects are obtained are in many cases really damaging to the sight.

There are certain first principles in the matter of lighting: (1) the source of the light must never be directly in the line of sight; (2) all lighting is relative.

The first of these principles seems almost self-evident. Every one knows that to look at the sun is dangerous. The sun is our chief source of light, and to get it directly into the line of sight is to risk blindness, temporary or permanent. It is so with

every source of illumination. To look straight into the light is to temporarily diminish the capacity of the eye to see; the eye is benumbed by the direct brilliance of the illumination.

The second of these principles states that all lighting is relative. There is no absolute standard of illumination so far as the eye is concerned. If we go into a cathedral that gives the impression of fair general lighting on an ordinarily clear day, we may see the walls and monuments. If we go into that building again when the sun is streaming through the clerestory windows, and stand in or near the sunlit space, we shall be quite unable to see the walls or monuments, except in places where there is sunshine, either direct or reflected. If we were to measure the light on each of these two occasions with a photometer we should find that the measure of the light on the second occasion would be two or three times stronger than on the first, but for all that we could not see so well because the patches of sunlight dazzled our eyes. Lighting is relative.

To learn those two lessons is to get at the secret of good lighting. Make your lighting even, prevent the exposure to the eye of any brilliant spots of light, then sight will be comfortable, and fatigue will be reduced to the minimum.

In these days we are sinners in this respect. When the sources of artificial illumination were weak and costly folk went to bed when it was dark, and their

eyes were well rested. When lights were feeble they were careful to get the most out of the light by the use of good reflectors. With the new forms of illumination, the electric arc, the metallic filament glow lamp, and the high-pressure gas lamp, the source of illumination is exceedingly small as compared with the amount of light that is emitted therefrom. It is this intensity of the light at the source that makes the new lights painful to the eyes; properly modified by well-arranged shades they are safe, exposed and unshaded they are dangerous in a manner that the old flickering, low-intensity candle, oil, and gas jet could never be. The tests of good lighting are comfort, restfulness, and withal sufficiency for the work or use of the place.

The environment of first importance in a school is light. Buildings necessitate windows, and when there are many rooms windows can only be fitted on one side. A single source of illumination produces shadows, therefore we must consider the source of light from the position of the child. Light from behind is absurd—the child sits in its own light. Light from the front is bad—the child is dazzled by the glare. Light from the right-hand side is poor—shadows are cast by the writing hand. There remains only the left-hand side, and light therefrom is at its best.

The left-hand wall of the classroom should carry one large window extending from four feet above the

floor to the clear level of the ceiling, and from the hind wall forward for a full two-thirds of the wall. Transoms and mullions should be as narrow and shallow as possible, and blind boxes should be recessed in the ceiling so that they do not encroach upon the window area. Where obscured glass is required, fluted glass should be used, and never ground glass, for this latter reduces light considerably. Sun-blinds for use in day-rooms in England should not be coloured, but of cream holland. With such windows in a fairly proportioned room, in a school built on a suitable site, each desk will be well lighted, and the blackboards and charts in the teacher's part of the room will show up well.

The site of the school is important. If the school building be in a crowded neighbourhood then the school windows are likely to be overshadowed by the near buildings. If this be so the best of windows will be useless, for the clear light of the sky, which should be visible from each desk in the room, will be cut off by the buildings. A crowded region is no place for a school.

Skylights give a fine light, but they are uncomfortable arrangements ; the room into which they are fitted is always cheerless, and suggestive of the well of an ancient prison into which the offender was dropped. Again, they are cold in winter, hot in summer, and dirty at all times. Such fitments are good for certain types of workroom, such as art-

rooms; but for the partial living-room such as is the child's class-room they are bad.

Some authorities favour windows on two sides of a room with the view of getting cross ventilation. From the point of ventilation such an arrangement is good, but from the view of the eyes it is bad; the eye is disturbed by the cross lighting, especially if the level of the windows be nearly similar.

In America windows on all walls is advocated by some, the idea being to imitate 'natural open-air conditions.' Such conditions cannot be imitated in a room. A room is a box with holes in it, and by no means can an enclosed space imitate the free open air and light of the earth. Neither is it desirable that we should imitate the conditions of the open sky for the workroom; it is not pleasant to read out of doors, the light is too strong in its reflection from the white surface of the paper.

The decorations and furniture of a room have a material effect on the light. White reflects the most light, but it is hard and uncomfortable to the eye if unrelieved. The ceiling and a frieze of two feet deep may be white. A pale grey or green tint serves best for the walls; it is restful to the eye and permits of the largest amount of reflected light that is possible with any other than white walls. The surface should be flatted, and on no account varnished, for that causes dazzling reflections. The lower three feet of the wall should be painted a rather

darker colour. The desk furniture should not be too dark: a light fumed oak is an excellent tint, and the wood should be wax polished and not varnished.

Artificial Light.—So far as is possible close work should be stopped when daylight fails. It is better to prohibit it for children under eight years of age.

The principles that underlie the planning of good schemes of artificial illumination are simple. They can be demonstrated by experiment: take an ordinary wax candle, set it in a stand; make an opaque shade of some stiff paper white within, fix it in a suitable frame so that it can be fixed around the candle.

Take the lighted candle into a dark room, and try to read some very fine print by the naked light; it will be difficult, for the light will be so close to the eyes as to dazzle them. Now put the shade on so that the naked light cannot be seen by the eyes, it will be found quite easy to read the finest print and at a fair distance; in effect, the shading of the light has increased its illumination manifold. That is the whole art of illumination. These same effects can be produced by lamp, gas, and electric light, and when so produced none of these illuminants are injurious to the eyes. Electric light has been debited with unduly tiring the eyes, but these effects have arisen out of the defective use of the light; well used it is better than any other light, for it is the only type

of artificial light that does not flicker, and that does not foul the air of the room.

Photometry, or measuring Light.—It is often necessary to measure the light in terms that can be recorded. We compare it with the light of a standard candle—that is, a candle that burns so many

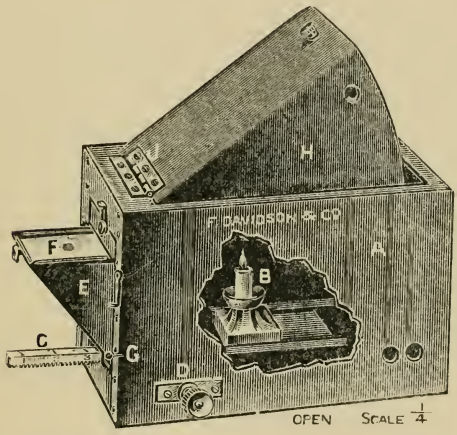


FIG. 18.—THE AUTHOR'S PHOTOMETER.
(*Davidson, Great Portland Street, London.*)

grains of wax in an hour; and the measure is the light of one of these candles at the distance of one foot. For convenience some simple piece of apparatus is needed. Fig. 18 shows one devised by the author. Within the box is the standard candle; it can be moved to and fro, nearer or farther from the indicator platform (F). The platform has a window in it screened

with waxed paper; when the light within the box in any position of the candle balances the light that falls on the window from without, the window cannot be seen, for both lights are of equal intensity. If the candle is the stronger the window is bright, when the outer light is the stronger the window is dark. When the point of equality is made out all that remains is to read off the illumination in standard foot-candles on the scale at the base of the box (C). Should we read off five foot-candles, that means the light of the room at the particular spot examined is equal to the light of five standard candles one foot away from the point of examination.

There are other and rougher methods of estimating the light. One that has been proposed by the school-lighting committee of the Society of Illuminating Engineers is the capability of reading diamond type (Fig. 19) at a distance of half a metre (20 inches).

This is Diamond Type.

FIG. 19.

If it can be done, the light will pass; if it cannot be done, the light is bad. The test is rough, for much depends upon the observer.

The standard of illumination fixed by that committee for artificial lighting of class-rooms was a minimum requirement of two foot-candles; for daylight no absolute standard was fixed, for so much depends

upon the condition of the light in all parts of the room. From many experiments my judgment is that no room that has in its darkest part light that is less than nine foot-candles on an ordinarily clear day is fit for class purposes.

How lighting can be varied by attention to details can best be shown by photometric charts of class-rooms, good and bad.

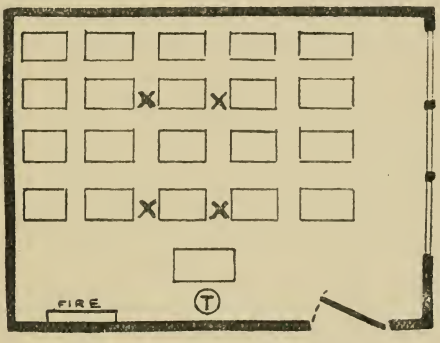


FIG. 20.—BADLY PLANNED ROOM.

X, points of light; *T*, teacher.

Fig. 20 shows a class-room. The plan is bad. The natural light is to the left of the children, but the desks are separated from the window by a gangway, so that the best region of illumination is unused! The artificial illumination is a typical gasfitter's plan. Four points of light are set close together in the middle of the room without any relation to the use of the room. The effect can be seen in the photometric charts of Figs. 21, 22, and 23. No. 21 is the lighting

as it was with naked fish-tail gas-burners. The light was everywhere insufficient, and, worse than that, it was in a constant state of flicker. No. 22 shows the

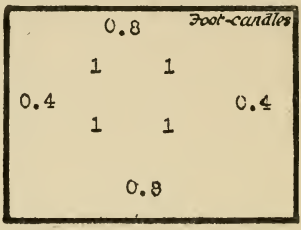


FIG. 21.—PHOTOMETRIC CHART. NAKED GAS JETS.

illumination when Welsbach incandescent gas-burners and the stock 'Calypso' type of shade were substituted: no more gas was consumed, but the light was

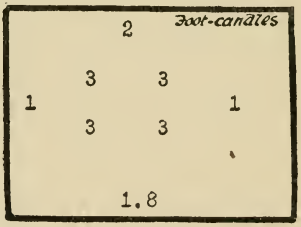


FIG. 22.—WELSBACH GAS, WITH STOCK SHADE.

good for the centre of the room, although insufficient for the sides. No. 23 shows the light when the best form of reflector with sides set at an angle of 90° to each other was used; then the room was fairly well lighted in all parts.

Fig. 24 shows a model class-room. The natural illumination is all that could be desired; there is also a 'squint' to light the blackboard. The artificial

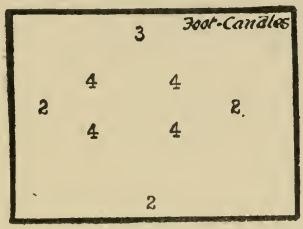


FIG. 23.—WELSBACH GAS, WITH 90° SHADE.

lighting begins also from the left-hand side, and is arranged so as to give an even distribution over the

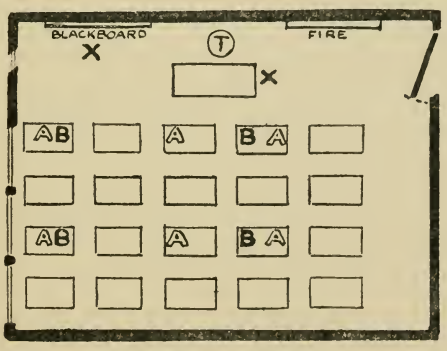


FIG. 24.—MODEL CLASS-ROOM FOR 40 CHILDREN.
T, teacher; *X*, special lights; *A* and *B*, positions of two schemes of ighting.

whole room. There is a separate point of light for the teacher's desk and for the blackboard, and both

are screened so that they do not shine in the eyes of the children. Two sets of lamps are marked, *A* and *B*; *A* provides for extra illumination of rooms where much close work has to be done.

The influence of shades and reflectors can be judged by experiment. Fig. 25 shows the manner of investigating the spread of the light along the tops of the desks five feet below the light. With

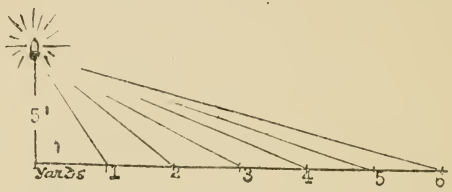


FIG. 25.—METHOD OF EXAMINING SPREAD OF LIGHT.

the photometer the power of the light was first read off immediately under the light, and then at intervals along the desk tops from one to six yards from the first spot. The first set of tests was made with an ordinary Welsbach burner and incandescent mantle, and the following results were obtained:

Shade.	Perpendicularly 5′ below burner.	1 yard.	2 yards.	3 yards.	4 yards.
None . .	0·1	0·2	0·2	0·1	0·1
'Reflex' globe	0·8	0·8	0·5	0·2	0·1
90° shade .	2·2	1·5	0·7	0·2	0·1

The increase in the desk illumination with the 90° shade is striking; there was no appreciable loss in the general room lightness, and the eyes were protected from the glare of the naked mantle. One other advantage was noticed, and the figures show it clearly: when there was no shade, or a stock pattern shade, there was a black shadow immediately under the light caused by the brass-work of the burner;

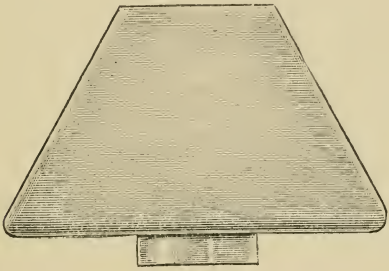


FIG. 26.—A WELSBACH SHADE-GLOBE OF SATISFACTORY PATTERN.

with the 90° shade there was no shadow at all. This is a considerable point in gas-lighting, for the inverted gas-burner should not be used in children's rooms, since upside-down burning produces more unpleasant fumes than erect burning.

Then the tests were made with electric lighting by the glow lamp, and the following results were obtained, which show just the same improvement by the use of an effective shade to reflect the light

downwards and protect the eyes from the glare of the exposed lamp.

Shade.	Perpendicularly 4′ below lamp.	1 yard.	2 yards.	3 yards.	4 yards.
None . .	0·5	0·3	0·1	0·1	0·1
110°, 3½″ deep .	2	0·9	0·5	0·3	0·1
80°, 5″ deep .	3	0·9	0·5	0·2	0·1

There are other methods of using light, known as the indirect and the semi-indirect. By these methods lamps are hung up within bowls, so arranged that the light is thrown on to the white ceiling, from whence it is reflected in an even intensity over the whole room. With the indirect the bowls are completely opaque, no light strikes directly downwards. With the semi-indirect the bowls are translucent, and allow about thirty per cent. of the light to strike directly downwards. These methods are delightful for rooms where there has to be continuous movement, as in play-rooms, or where large masses have to be shown, as in museums. But they are expensive, for a great deal of the light is lost by absorption into the reflecting surfaces. Of the two the semi-indirect is by far the more comfortable to the eyes, and it gives better illumination for a given expenditure. Of indirect methods the cornice fashion of lighting is the most pleasant. The light is placed two or three feet down the wall within a deep cornice, from whence it is reflected by the walls and ceiling over the whole room.

CHAPTER X

READING

HOWEVER excellent books may be in their matter and in their print and paper, there is a proper place for them, and away from that proper place they are like dirt—matter in the wrong place. They are out of place in the infants' departments. There work should be modelled on the plan of the primitive school, when books were too costly and rare to be owned by any one of lesser years than the teacher. For the infant, the sand-tray, the black-board, and in their highest class only, the large paper sheet, are all the equipment that is fitting for reading and writing. The myope class is the ideal model for an infants' school.

The first thing about a book that should engage our attention is the binding. It must open flat, otherwise the print will be unreadable ; many good school-books are ruined by bad binding. The paper of the book should be of a smooth, even texture, neither glossy nor rough. If it be glossy then in certain lights there will be reflections from the pages, and it will be quite impossible to see the print thereon

without fatiguing the eye. The paper must be of just sufficient thickness to prevent the print of the other side of the page showing through. The type depends for its character upon many points: size, boldness, face, the tags and finishes or 'serifs,' the hair lines, and lastly, that most important matter, the spacing of the words and the lines. A good type of print may be marred and rendered unpleasant to the eye of the reader by a fault in any one of these points.

In the report of the British Association there is a typographical table showing the scale of print and the relation of lines and spacing for children of different ages. It is reproduced here:

STANDARD TYPOGRAPHICAL TABLE

Age of Reader.	Minimum Height of Face of Short Letters.	Minimum Length of Alphabet of Small Letters.	Minimum Inter-linear Space.	Maximum No. of Lines per Vertical 100 mm. or 4 inches.	Maximum Length or Measure of Line.
Under 7 yrs.	3·5 mm.	96 mm.	6·5 mm.	10	.....
7 to 8 yrs. .	2·5 mm.	72 mm.	4·0 mm.	15	100 mm. or 4 in.
8 to 9 yrs. .	2·0 mm.	55 mm.	2·9 mm.	20	93 mm. or $3\frac{2}{3}$ in.
9 to 12 yrs. .	1·8 mm.	50 mm.	2·4 mm.	22	93 mm. or $3\frac{2}{3}$ in.
Over 12 yrs.	1·58 mm. or $\frac{1}{16}$ inch	47 mm.	2·2 mm.	24	93 mm. or $3\frac{2}{3}$ in.

Fig. 27 shows a 'typometer,' devised by the author, to measure the type. It consists of a metal tube

containing a high-power lens; at the bottom of the tube is a millimetre scale; when the instrument is set on the print there is seen through the lens side by side the magnified print and millimetre scale.

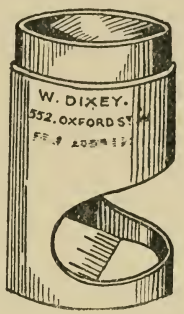


FIG. 27.—THE AUTHOR'S 'TYPOMETER.'

The second column of figures seen in the table indicates the breadth of the letters. This cannot be given for the separate letters, as these vary. A fair judgment can be obtained by measuring the length of a word of thirteen letters and doubling that.

to be read by children from

to be read by children from

FIG. 28.

Size in type does not mean height only. Tall type gives a dazzling palisade effect, and it is less legible than shorter and broader type. We read along the tops of the letters and the chief points of recognition are there (see Fig. 28).

Fig. 29 shows a model type; it is bold and clear, the letters form distinctive words, and the spacing is

This type may be used for books to be read by children from seven to eight years old. Printed from Eighteen Point Old Style Antique.

FIG. 29.—SPECIMEN NO. 4, BRITISH ASSOCIATION REPORT. A MODEL TYPE.

perfect. The same type is shown without proper spacing in Fig. 30, and it is ruined. It is false economy to

This type may be used for books to be read by children from seven to eight years old. Printed from Eighteen Point Old Style Antique.

FIG. 30.—GOOD TYPE SPOILED BY ABSENCE OF LEADING.

attempt to save space by cutting down the leading; legibility is destroyed and the book rendered worthless.

There are some books that ought never to be published as a whole for school use. Shakespeare and the Bible. Neither are whole books. And there is no reason why the Bible should be issued to the

children in one volume of thin paper and poor print that would be counted bad for a trade catalogue.

Recently I collected the used pages of some two dozen school Bibles that had been withdrawn from different schools as being too dirty for further service. The used pages were so dirty that the print was in many parts illegible. But the unused parts of the books were as clean and untouched as the day they came from the press. When all the used pages of these Bibles were collated, it was evident that less than one-fourth of the whole Bible was made use of in these schools! We want a school Bible of one-fourth the present mass; and this, produced in the size of an ordinary school Bible, would allow of good paper and good print, and the result would be worthy of the greatness of the book and the use to which it was to be put. If Cromwell in the days of the civil war, when the Bible was the one and only book, could make a 'Soldier's Bible,' there is no reason why we cannot have a 'Children's Bible.'

Lastly, on the manner of the use of a book. It should always be set up on a frame or reading-desk at an angle of 60° with the horizontal; it should be on a relatively high level, with the bottom edge a very little lower than the chin. It should never be held any nearer to the eyes than twelve inches, and the farther from the eyes it can be read the better. The ideal reading position is that seen in any church. There is the lectern with a large-print Bible set up at

a good angle and convenient to the eyes of the reader. The standing position is excellent, for when the limbs are tired of holding up the body it is full time for the eyes to cease to read. Albeit there is one point in which the church building is rarely conducive to good vision: the lighting, 'the dim religious light' is not to be copied in the nursery or the school. Such counsels of perfection are scarcely possible in every-day life. But we may fairly insist on a good position during reading, and totally inhibit the slovenly crouch that children habitually fall into when absorbed in a story-book. One other practice should be inculcated. Reading should cease for a few minutes at frequent intervals; the eye is rested, and the momentary meditation will increase the value of the reading.

CHAPTER XI

WRITING

PENMANSHIP affects the sight of both writer and reader. The writer is doubly affected; the legibility of the writing influences his eyes, but the attitude assumed during writing has an even greater effect upon his eyes. That the reader is tried both in sight and in temper by bad writing is evident.

The style of handwriting is affected more by materials than by any other circumstance. Differences in material will explain the divergence in the styles of writing of the world races.

The near Oriental script, e.g. Hebrew, is written from right to left and in discontinuous letters. That script had its origin in the delta of the Nile; there the most ready material was the reed, the prototype of paper. With such material single-handed writing is natural. The movement from right to left is determined by the balance of the muscles. The flexor muscles that bend the fingers and arm are more differentiated than the extensors that straighten them and throw out the arm; there are eighteen flexors and only eleven extensors. Fine movements of the

hand are best controlled by the flexors, and by them mark after mark can be most regularly placed from right to left. We teach our children a single-handed writing, and find they often begin to write from right to left; this perversity is a puzzle to the teacher, but it is easier so to write.

Our western style arose on the rocky shores of the northern side of the Mediterranean. Rock was the material at hand. Our script was two-handed—the left hand held the cutting tool, whilst the right delivered the blow. Sight compelled work from left to right, for in that way only can the letter already graven be kept in view. When the stone gave place to wax and style there came single-handed writing, and since the extensors are swift rather than deliberate our originally discontinuous script has become continuous and cursive.

The far-eastern Chinese vertical script is essentially brush-work; and, controlled by gravity, down comes the aching arm!

Our early penmanship had a bold, upright stroke, the effect of parchment, coarse paper, and the quill; the delicate, sloping Italian hand is the outcome of fine paper and the steel pen. The new materials led the writing-master to emulate the florid work of the engraver, forgetful that this work was designed to render the subscription scarcely noticeable to the eye lest it should compete for notice with the picture!

The Italian hand was bad, not only because it was

of poor legibility, but because the doing of it involved cramped hands, twisted bodies, and eyes that were set unequally before the work to be done; all induced a fatigue altogether disproportionate to the nature of the task.

In recent years, thanks to the labours of Mr. George Jackson, there has been a return to the upright style of handwriting; the change is in every way to ad-

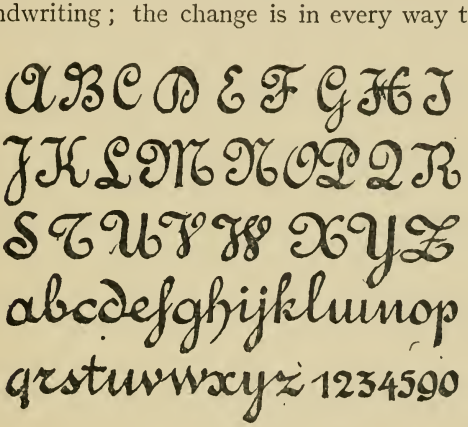


FIG. 31.—ENGROSSING HAND.

vantage, the writing is easier to produce, and it is easier to read. The only criticism that can be advanced against the new style is that it is uncommonly ugly. That is the effect of two conditions. The schools that have adopted the upright style have kept the old fine-pointed pen; a good upright hand can only be produced with a broad, smooth-pointed pen. Again, the model on which the writing is

planned is none other than the Italian hand, and this does not look well when it is straightened up. It would be far better to adopt one of the fine old styles such as the beautiful 'engrossing hand,' than which nothing could be more pleasing to the eye or more convenient to the hand. Another essential of a good writing habit is the recognition that the Italian style of holding the pen is quite wrong for an upright hand. The child should be taught to hold the pen with the holder pointing *away from* the body; in this position the flexors get the best control of the instrument and the work is proportionately easy. There is no doubt that the natural slope of the writing, from the writer's point of view, is from left to right, just the reverse of the Italian hand. This can be demonstrated by the examination of any copy-book that contains the initial efforts of the infant. The first pot-hooks will be a fair imitation of the copy, the succeeding will lean more and more to the left. On one occasion I collected some infants who had never made any attempt to write. Each was shown a large vertical straight line, first on the sand-tray and then on paper. By way of imitation they drew their chubby fingers from the top left-hand corner of the tray towards the bottom right-hand corner. It is worth remembering these little natural difficulties lest we press our conventions too rapidly upon them.

One thing is certain: all pens, copy-books, slates, and pencils should be banished from the infants'

school. The initial lessons in writing should be made with the finger on the sand-tray. Slates should never be used; they are dirty, and marks thereon are difficult to see. Succeeding the tray there should be the blackboard and chalk. The board should be set up at a slight angle from the vertical; all work should be done free-arm fashion and in large size. When there is a desire for some permanent record sheets of coarse paper should be clipped on the blackboards and the work be done with crayons. It is time enough for the infants to learn the use of pen and pencil and paper when they have arrived at the age of seven. Such a reasonable limitation as this would do much to check the early onset of eye troubles.

CHAPTER XII

SEWING: HANDICRAFT: DRAWING

NO child should make the acquaintance of the ordinary sewing-needle before the age of seven years, for its use is certain to be fraught with evil to the eyes, and perhaps the general health, of the child.

The reason for this denunciation of needlework for young children is to be found in this one fact: no child can be persuaded to do what we know as sewing at anything like a safe distance from the eyes.

Dr. Louisa Woodcock, in 1909, investigated the habits of children in sewing. In one hundred children in several classes, from six to ten years of age, doing either sewing or knitting, 84 per cent. held their work at from four to six inches distance from the eyes, or even nearer, and the 16 per cent. who had a better working distance were mostly engaged in knitting. Not one child in the whole hundred did her work at the distance of twelve inches from the eye, which was the distance prescribed by the rules of that school.

These observations are startling; they show the difficulty of controlling the practice of fine work.

In the fineness lies the whole difficulty. Work that is fine demands the concentrated attention of the child, and when that is engaged the child tends unconsciously to get closer and yet closer to the work. The reason for this is to be found in the fact that the nearer we can get to an object the larger is the image that our eyes get of it, and consequently the more impressive is the effect upon the brain.

In these children the evidences of strain were many: (1) There was a bad position of the body, the work being pressed close to the chest to obtain a *point d'appui*, entailing a stooping posture, and rounded and high shoulders. (2) Squinting, set up by the excessive convergence of the eyes. (3) Corrugated forehead and knitting of the brows. (4) Twisting of the body and neck, the head being held sideways from unequal action of the muscles of the two sides. (5) Grimacing, open mouth, and associated action of the muscles of the face with the movements of the fingers. These are often merely tricks of manner, but they are liable to be the start of 'habit spasms' in nervous children.

Girls must learn needlework. And most boys find it useful in after life to have some knowledge of the handling of a needle. Most of the bad effects of the teaching of this necessary subject come about by the endeavour *to get something done*. We should be content rather to teach the methods with large-scale materials, believing that with the knowledge of

the method there will come in later and more robust years the capacity to make practical use of these lessons.

Knitting is a less absorbing task, and the distance at which the child will do it, even when not under the eye of the teacher, is better and safer.

One word must be written on the materials to be used for these early lessons. The wools had better be of the duller colours, and not of brilliant reds and yellows. Canvas should be of an unbleached tint, and wools of the green and brown shades are the least dazzling to the eye, and therefore the more restful.

In later years when children are allowed to practise needlework, there are certain rules that must be put into force. The work should never be done by artificial light; if the natural light fail then that lesson should be postponed. The light of the window must fall upon the left-hand side of the child and of the work, so that the sewing hand does not overshadow the light. Let the periods of sewing be short with intervals of other work in between, say half an hour of stitching to be followed by five minutes' interval of body movements. Never let a child count stitches. And last, and by no means least, if a child should be found to excel in the fine sewing, insist upon her eyes being examined lest she be short-sighted. There are not a few cases on record where girls who have shown great skill in needlework and embroidery have been exploited by ignorant teachers

for the production of competition work, and even embroidery for church purposes, to the grave injury of their eyes.

Handicraft for boys has few dangers to the eye, and many advantages over all forms of schoolwork. First and foremost it is most natural work, for in doing it the child is all motion. Arms, legs, body and head are all agog, and the motion is all to the good. Contrast the positions of the child in the class-room and in the workshop. In the class there is a teacher who is 'an excellent disciplinarian,' and the children are like little Buddhas, rigid in the perfection of obedience.

A child with ordinarily healthy eyes may do any handicraft. In the case of children with short-sighted eyes we must ask, Can the child do the particular sort of work without undue or too prolonged stooping? Judged by this test there is a great difference between carpentry and bent-iron work. In carpentry the head is almost always bent downwards towards the bench; it is quite useless to attempt to raise the bench to a near level of the eyes to prevent stooping, for then the muscles of the arms and shoulders lose all power over the tools, and the work is unduly fatiguing. Bent-iron work, on the other hand, can be done standing or sitting; the bench may be at a comparatively high level, and, best of all, the work is done for the most part with the eyes looking straight forwards.

For short-sighted children sewing should be prohibited at any age. Knitting may be done if the child shows aptitude, and can do it more or less automatically. Small children may be taught paper-folding, stick-laying, felt-weaving in colours, and knitting. The older children and some juniors may be taught map-modelling and rough wood-work, where measuring can be done with rulers marked with quarter-inch marks. Advanced basket-work may be taught, but not including raffia work, which is too fine. Bent-iron work is particularly satisfactory for the boys. Netting of hammocks, tennis-nets, etc., may be done by boys and girls. For the girls cookery, laundry, and simple housewifery may be used as a substitute for the sewing lesson.

Drawing.—In the last ten to twenty years the teaching of drawing has been so revolutionized that there is little room for criticism, but much for praise. The manner of the training, the materials used, and the type of model chosen are as far removed as can be from the old-time teaching of 'freehand drawing,' or rather the copying of stiff line copies. Recently in watching the work of classes in several different types of schools there was no fault to find with the general style of work. In a few instances models of too small size were set up for drawing. Also free-hand drawing was being practised from a large-scale copy hung up on the blackboard. The copies were found to be unsatisfactory, in that they were printed

in dark grey ink on tinted paper; the contrast was not sufficient to render them visible at a sufficient distance.

A word of caution is needed on the use of 'squared paper' for use in mechanical drawing and perspective. The rulings must of necessity be weak and pale in tint, otherwise they overpower the subject of the drawing; therefore such papers must only be used by well-grown children, and only in rooms where there is natural daylight of the most perfect type.

CHAPTER XIII

CATARACT

CATARACT is the name given to opacity of the lens of the eye. It means literally a pouring down. It got this application before the facts of cataract were known, and it merely meant that something had gone over the sight.

To appreciate cataract the origin of the lens must be understood. Reference should be made to Chapter I. on the growth of the eye and to the pictures of the early eye. The crystalline lens, the teeth, the hair, the nails, and the numerous skin glands of the body, although so different in their final forms, have each a similar origin and mode of development. They spring from the surface tissue that makes the epidermis or scarf skin. They commence their growth by pushing down as pits into the underlying tissue that makes the general skeleton and musculature of the body. These pits become flask-shaped, and from the cells at the bottom of them there grow up these appendages of the skin—nails, the hair, teeth, etc. In the case of the lens of the eye there is no return outgrowth, for the connexion of the lens

pit with its mother surface cells is cut off, so an island-like sphere of cells is buried to continue an isolated development. Within the limits of this sphere the solid lens is produced.

The cells within the sphere elongate, become fibrous, assume a clear, transparent character, and spread over each other in neatly arranged layers. The fibres are cemented together by a fine glue, and the whole lens is enveloped by a clear elastic capsule.

Since the lens is made up of many fibres glued together along their contour and also at the ends where they meet in radiating lines, it follows that a very little defect in this delicate joinery will result in flaws of the lens. Indeed, no lens is absolutely perfect. To the eye with the most perfect vision a distant point of light appears as a 'star,' that is, a point of light with several rays; these rays are the dispersion of the light along the flaws of the joints of the ends of the lens fibres, and each ray coincides with a line of joinery. When these lines are grossly marked one form of cataract is present.

The outgrowth of the nails and the enclosed growth of the lens are both specialized in that their substances become transparent. A very little injury to the nail-bed, from accident or from disturbance of growth by severe illness, will produce flaws in the nail which appear as white marks. So with the lens; serious disturbance of its nutrition will cause a whole layer of fibres to be badly formed or shrink, and

fluid is deposited in minute drops along their lines. These defective layers of fibres are more or less opaque, and form a cataract.

Cataract in children is frequently divided into two classes according to the time at which the disturbance of the lens is believed to have happened. One is called 'congenital' cataract, because the child is born with the cataract already in the eye. The other is called 'infantile' cataract, because the cataract is formed after the child is born.

Congenital cataract has many different forms. Some are very curious; they rival the eccentricities of the Venetian fancy glass workers, but they cause bad sight or even blindness. Many are hereditary; their occurrence has been traced for generations in many pedigrees.

Not all congenital cataracts are due to inheritance; many are due to pre-natal arrest of development. For some reason the nourishment of the infant developing within the mother is arrested, and the delicate structure of the lens is affected. Other congenital defects of the eyes and of other parts of the body, such as hare-lip and cleft palate, are produced in the same way. Since the eye in its development is so closely associated with the brain, a shock of sufficient degree to disturb the lens may also disturb the growth of the brain. Many children who have congenital defects are not quite so smart as their normal playmates. Further, the disturbance of the

growth of the eyes is not confined to the lens; it affects the retina to some degree, so that even when the surgeon has successfully operated on the eye and removed the cataract the sight may not be so keen as in ordinary children, nor so good as in children operated on for infantile cataract.

Infantile cataract comes on after birth, and is the result of some illness, such as fits, rickets, or digestive

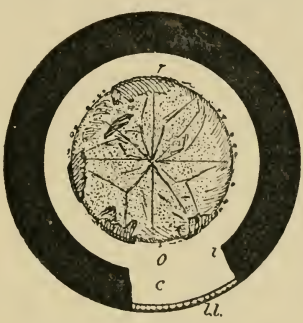


FIG. 32.—CATARACT.

i, iris; cut away at *c* to show edge of lens, and *ll*, ligament; *o*, main opacity; *r*, secondary opacity.

troubles. The cataract is not unlike the 'alley marble' beloved in boyhood days. It was a sphere of glass, clear for the greater part, but within its core was embedded a device of threads of coloured glass arranged in spherical or spiral fashion. The cataract is something like that; instead of a wholly clear, transparent lens there is within it a layer of opaque substance.

Cataracts of both orders are usually, but not in-

variably, found in both eyes. The opacity varies in density and in size; in some it obstructs vision completely, in other cases fair vision may be obtained either through the substance of the opacity when it is thin, or around its edges when it is of small diameter. When the opacity is so marked or large that the child cannot see through it, then the cataract should be removed. Operation is quite a safe procedure, and can be done in infants under a year old. The earlier it is done the better, for there is so much the better chance of the back of the eye, the retina, getting the necessary stimulus to enable it to attain a satisfactory growth.

The operation consists in removing the damaged lens, so as to make once more a clear pupil and a free path for the rays of light to the back of the eye. When that is done the loss of the lens is made up by the wearing of spectacles.

CHAPTER XIV

WORD-BLINDNESS AND COLOUR-BLINDNESS

THESE two defects are of great interest, though they are not very common. They are not defects of the eyes at all, but are really mental defects. But that does not mean to suggest that the subjects of these peculiarities are 'mentally deficient'; indeed, the reverse is often the more true. Certainly this is so in the case of the subjects of colour-blindness. Some of the affected are brilliant members of society, and the discoverer of the defect, Dalton, the great scientist, was himself colour-blind.

Colour-blindness occurs in about three to four per cent. of males, and in a smaller number of females. It is frequently hereditary, and the manner in which it is handed down through generations is peculiar. The males suffer from the defect, but the females carry it on. A mother may have good colour vision, but if she comes of an affected family her sons may be colour-blind, but her daughters may not be; yet these girls may have the defect latent within their germ plasm, and their sons may be colour-blind.

Colour-blindness is a defect in the registering

apparatus in the brain, and in some sort a reversion to a primitive condition. It is incurable. Many colour-blind persons are able by a carefully trained judgment of light and shade to detect the differences between coloured objects and correctly name those differences. But ask them the name of one isolated colour, and their incapacity may be disclosed at once. It is of importance to recognize the defect early and to turn the attention of the pupil to work in which his lack will present no handicap when the time for the labour of life comes. Such children should early learn there is no work for them at sea, or on the railway.

Word-blindness is a much more serious defect, for it cuts off those marked by it from ready appreciation of the ordinary means of communication by print. They see correctly. Tested with figures or pictures they may pass the standard. But the letters of the alphabet when strung together to form words convey no meaning to them. The defect is due to a want of association of the brain centres. Reading after the western method is a performance that requires a high degree of cerebral association. The eyes see first letters, then combinations of letters. What the eyes see is translated into sensible ideas by the correlation of the sight centres of the brain with the educated memory centres. In the ordinary subject the association has become by training almost automatic.

The defect is usually mistaken at first to indicate some visual incapacity, but the examination of the eyes readily leads to their exoneration. It is noteworthy that these same children may show considerable facility in reading figures, even money sums. In this work the association is much less extended; the symbols are shorter for the idea that they are intended to convey. This gives the clue to the best mode of teaching these children. They must be taught on the plan of the Chinese. The Chinese script is a sign script, each word or idea has its own symbol; the idea is not conveyed by a string of letters in combination, but by one particular sign. A certain mark conveys to the taught child the idea of a house, just as does a picture, or as the symbol 1 the idea of unity or one. To teach these children reading we must fall back on this plan. The word 'cat' must be taken as a whole, not as *c a t=cat*, but the whole thing is the sign for cat. The method is known as the 'look and say' plan, and when carried out by a teacher of intelligence and with great patience, it is possible to teach the child to read. In such cases it is obvious that individual teaching is necessary to secure any effective progress.

There are differences in the degree with which the defect is found. Those which have it in small degree are most likely to be overlooked, and such children get into constant difficulties with teachers who are not themselves quick enough to recognize

that they have to do with something other than stupidity. This defect when of small degree produces children who are bad readers or execrable spellers.

Such a condition as this brings this little book very fittingly to a close. The time was when, according to a crude but established usage, the mistakes of the child were debited to an extra dose of original sin which the rod of correction would drive far from him. To-day we know that some of these defects are indeed in their essence due to a dose of original defect, but the child is not responsible, and punishment is no fitting treatment. We now try to discover the circumstances of these defects; and the more care we take in these investigations the better our success in the treatment of them.

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